

Elephant Butte Reach Middle Rio Grande

Prepared For:
The US Bureau of Reclamation
Albuquerque Area Office
December 1st, 2021

Presented By:
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Colorado
State
University



Reach Overview

Elephant Butte Reach		
Subreach	Agg/Deg Lines	Justification
EB1	1637-1672	Start: Southern Boundary of Bosque Del Apache New Mexico End: Marks a decrease in cumulative widths
EB2	1672-1696	Start: Marks a decrease in cumulative widths End: Marks an increase in cumulative widths
EB3	1696-1728	Start: Marks an increase in cumulative widths End: Marks a decrease in cumulative widths
EB4	1728-1751	Start: Marks a decrease in cumulative widths End: Marks an increase in cumulative widths
EB5	1751-1794	Start: Marks an increase in cumulative widths End: Previous temporary outfall of the low-flow conveyance channel & possible reservoir effects (Owens, 2012)
EB6	1794-EB-63	Start: Previous temporary outfall of the low-flow conveyance channel & possible reservoir effects (Owens, 2012) End: Beginning of Elephant Butte Reservoir



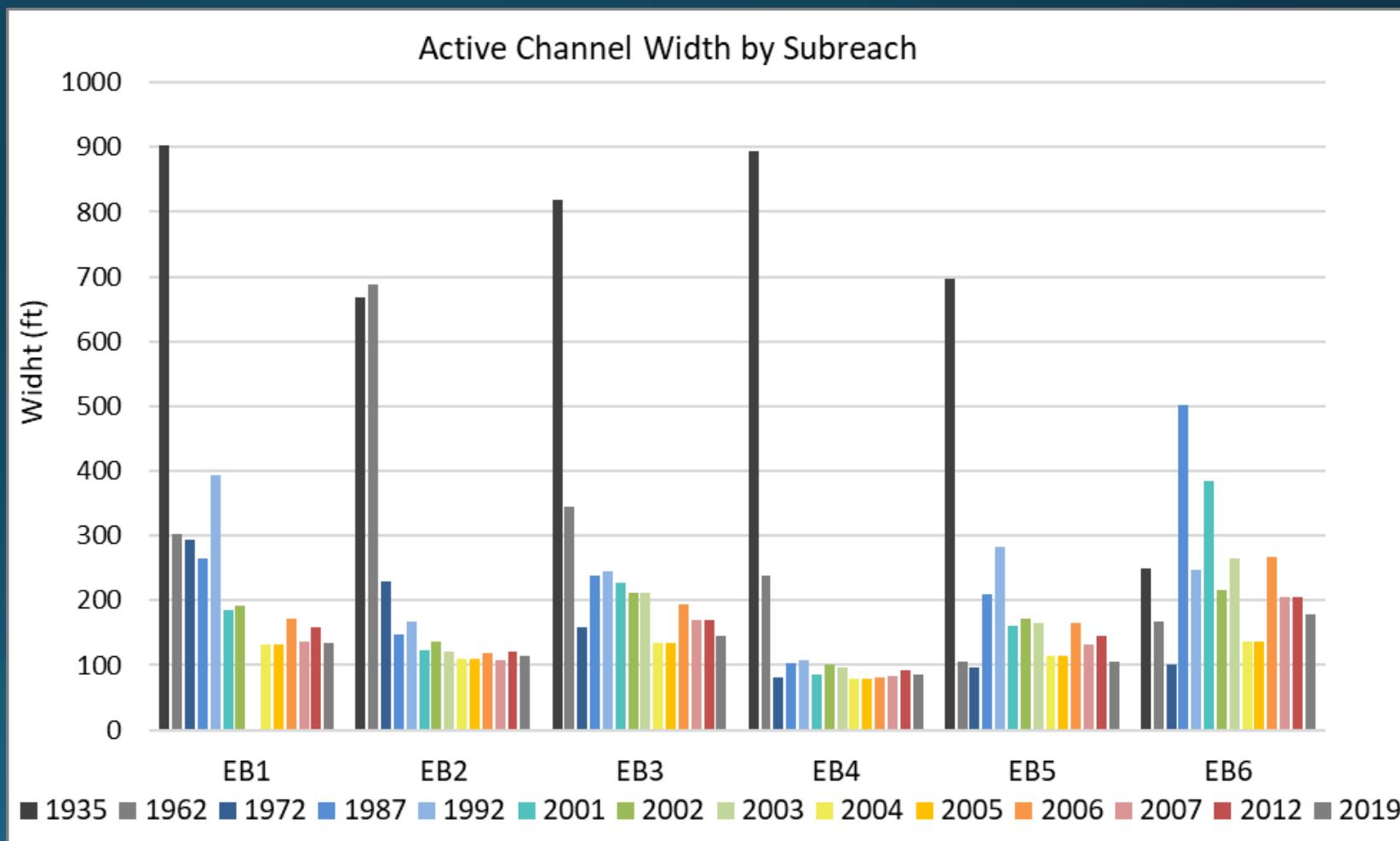
Elephant Butte Reservoir

Reach Report Objectives:

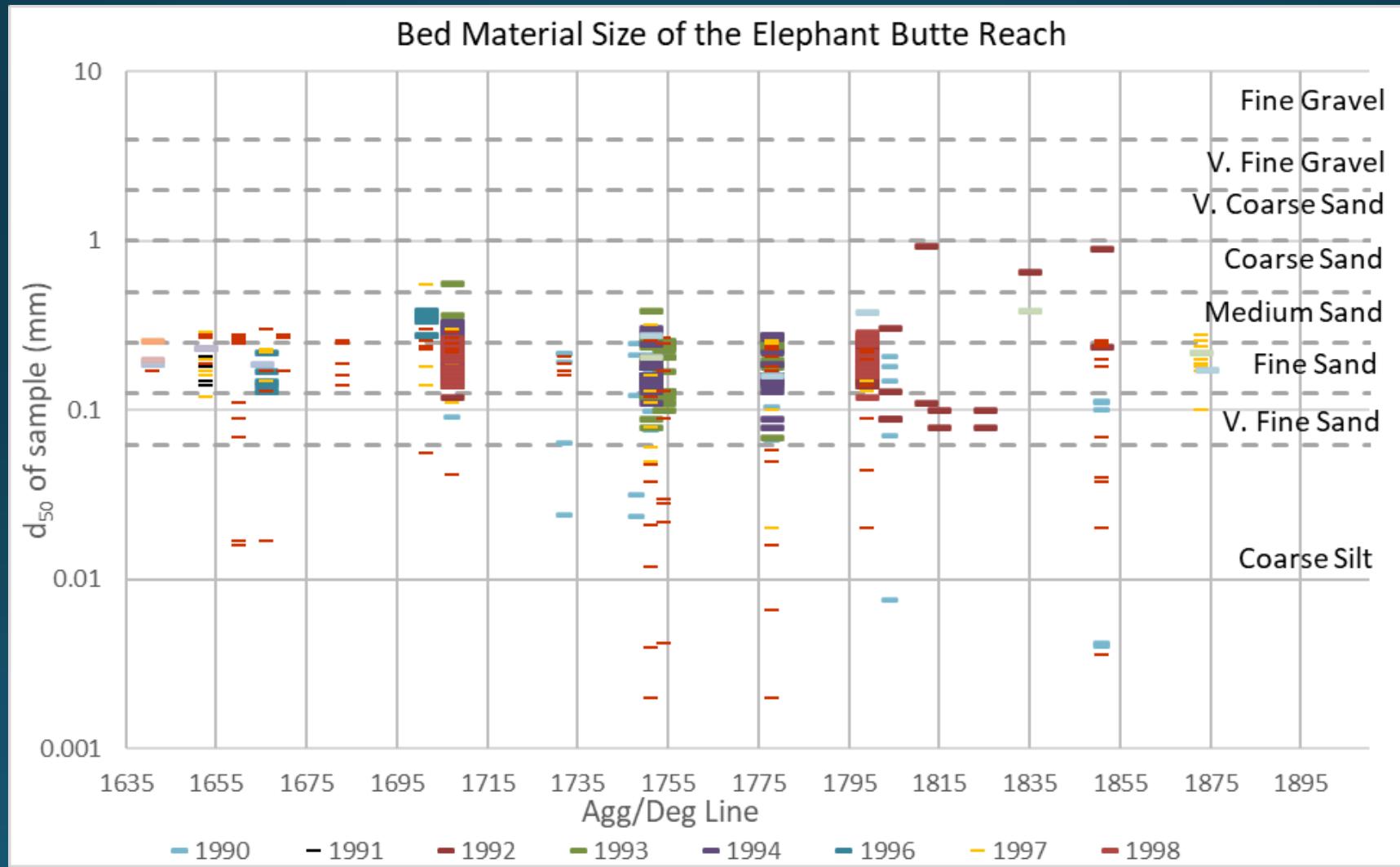
- Summarize the flow and sediment discharge conditions and trends for the period of record available from United States Geological Survey (USGS) gages and Elephant Butte Reservoir water level;
- Analyze geomorphic characteristics at a subreach level (sinuosity, width, bed elevation, bed material, and other hydraulic parameters);
- Link changes in the river geomorphology with shifts in sediment and flow trends;
- Understand and model potential Rio Grande Silvery Minnow habitat throughout the Elephant Butte reach.

Active Channel Widths

- Generally, has decreases and stabilized around 100 to 200 feet.
- Subreach EB5 and EB6 has fluctuated potentially due to reservoir effects .

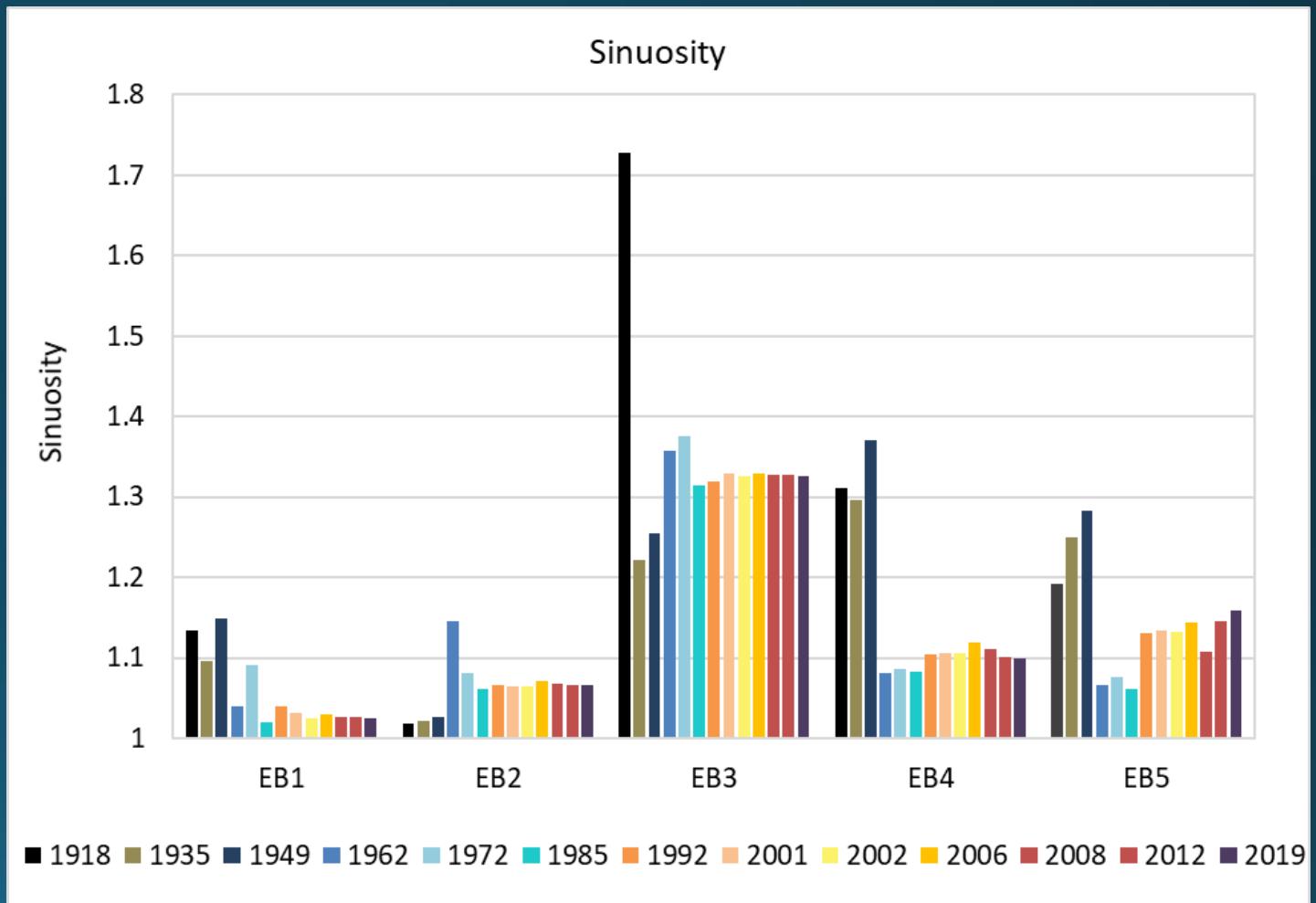


Sediment Size Distribution Through Elephant Butte Reach



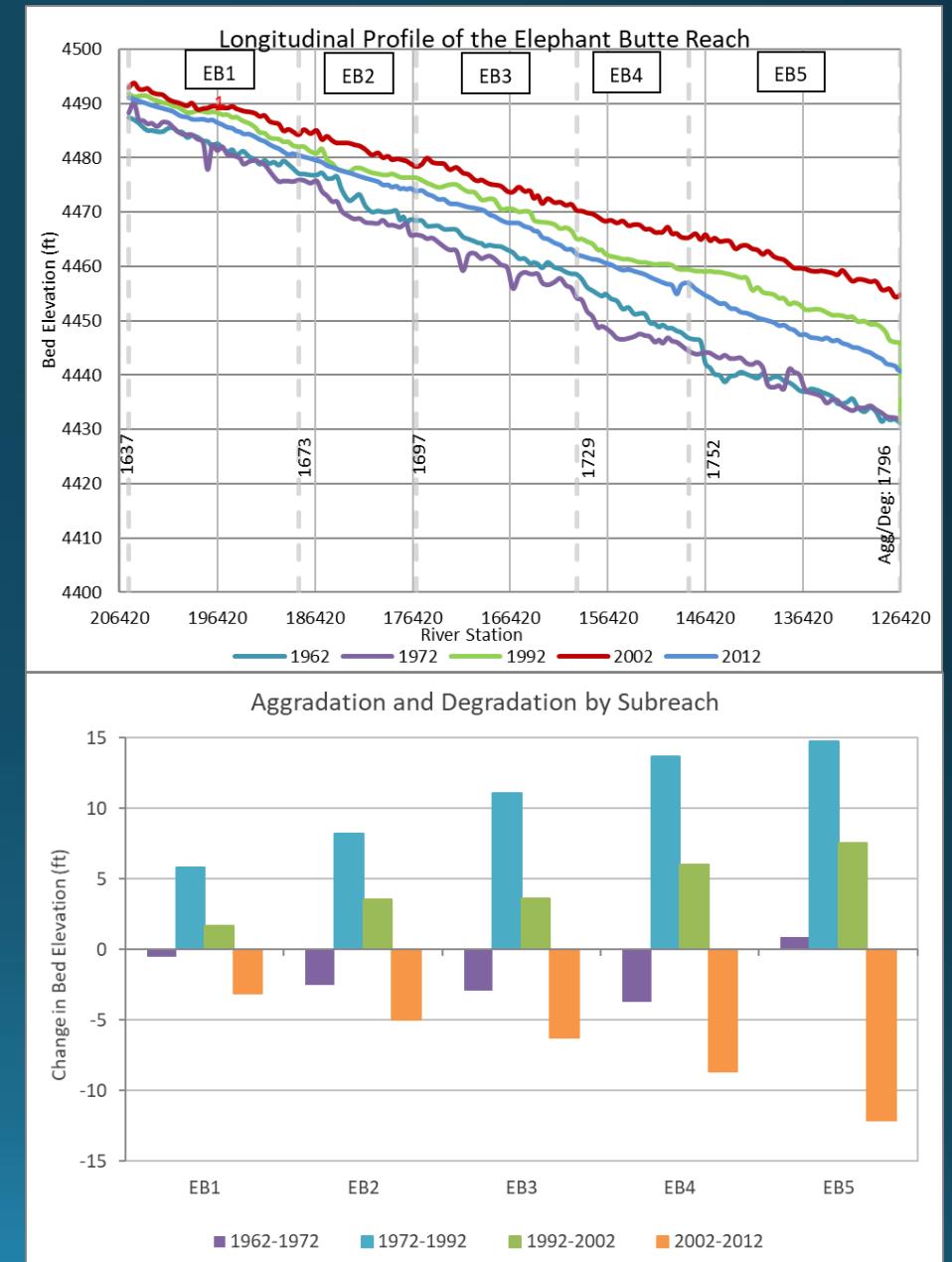
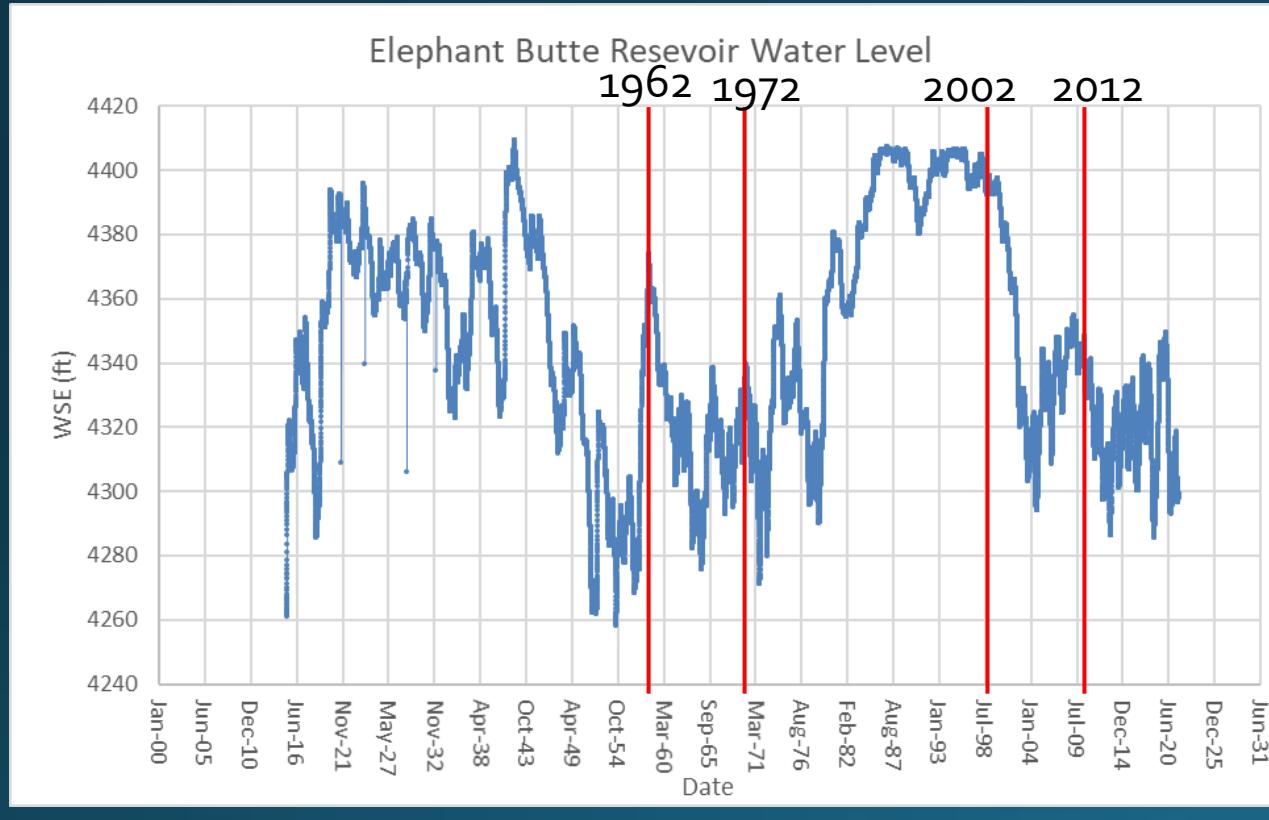
Sinuosity

- Generally, has decreases and stabilized
 - Subreach EB3 has become more sinuous since 1935



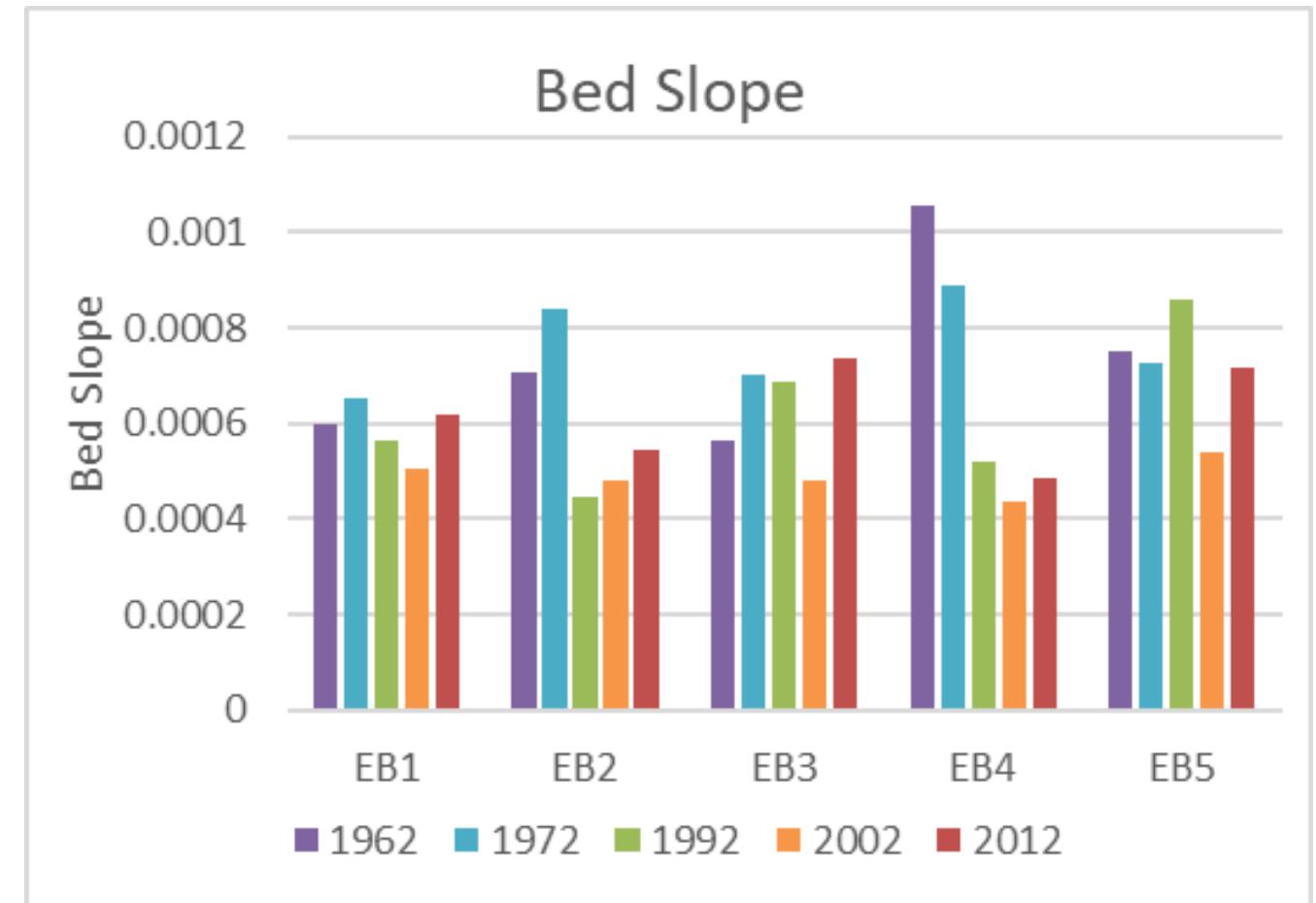
Aggradation & Degradation

- How has the river reacted and changed over time?

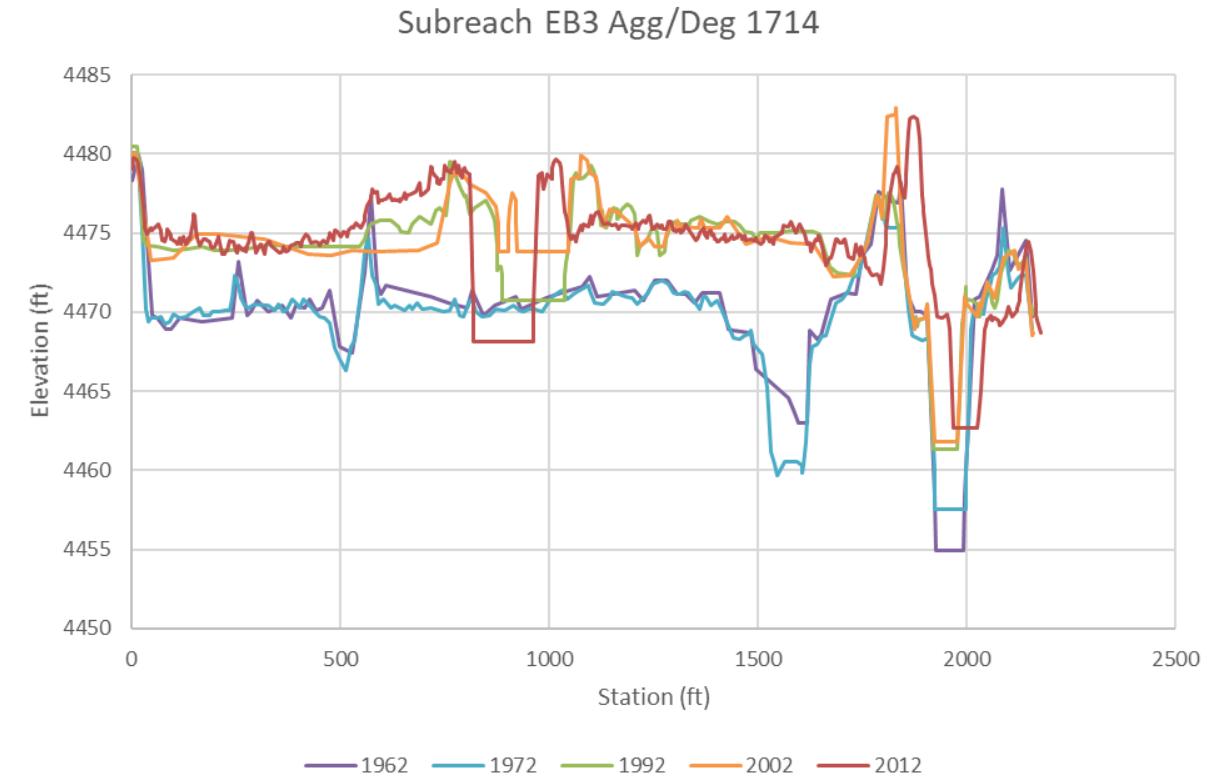
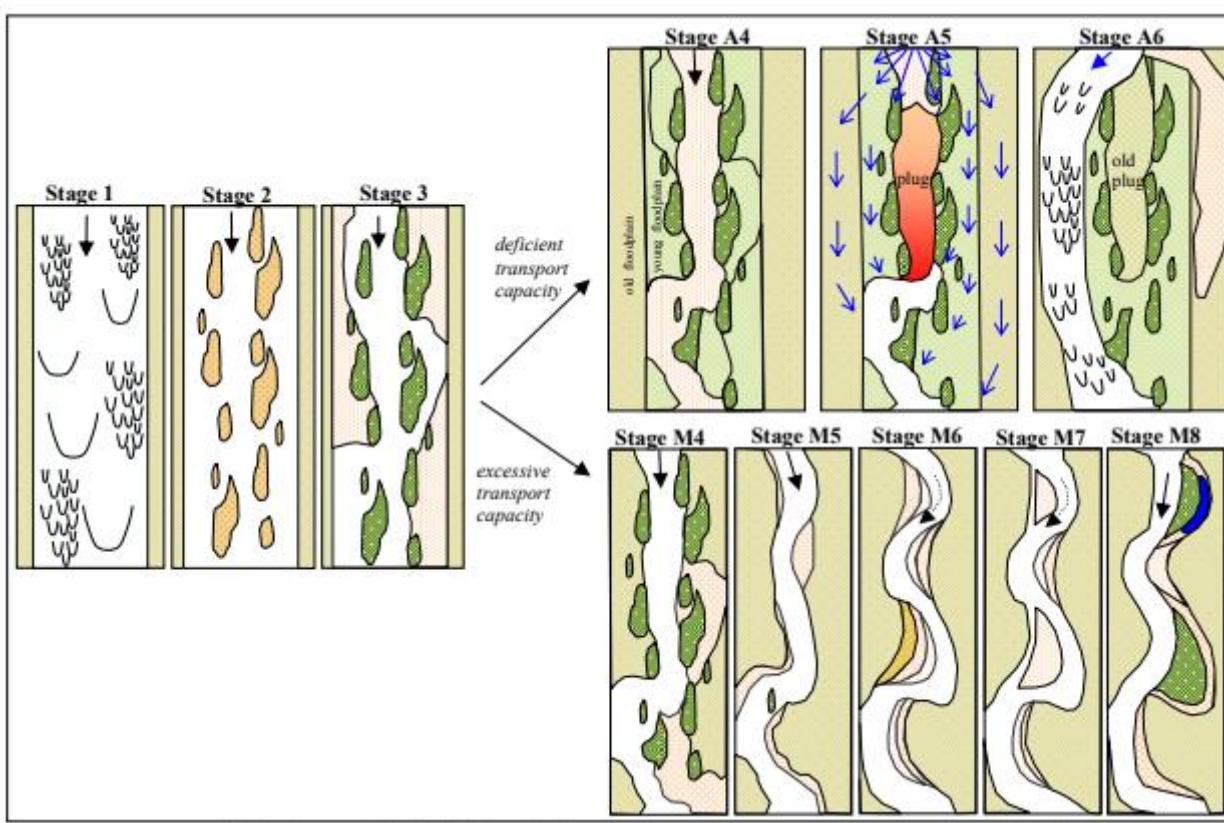


Bed Slope

- Slope has stayed relatively the same.
- In general, aggradation has a decrease in slope.
Degradation has an increase in slope.



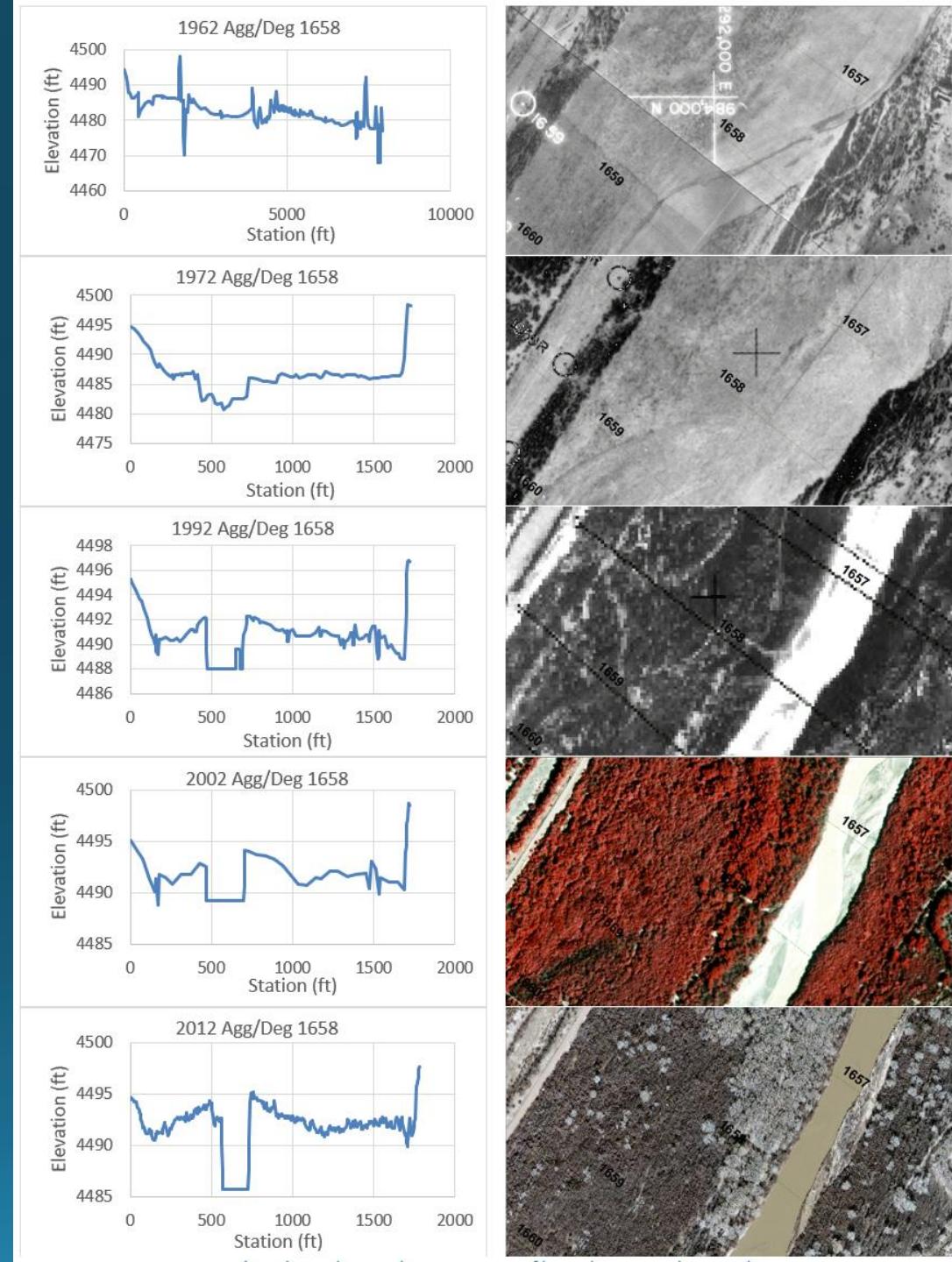
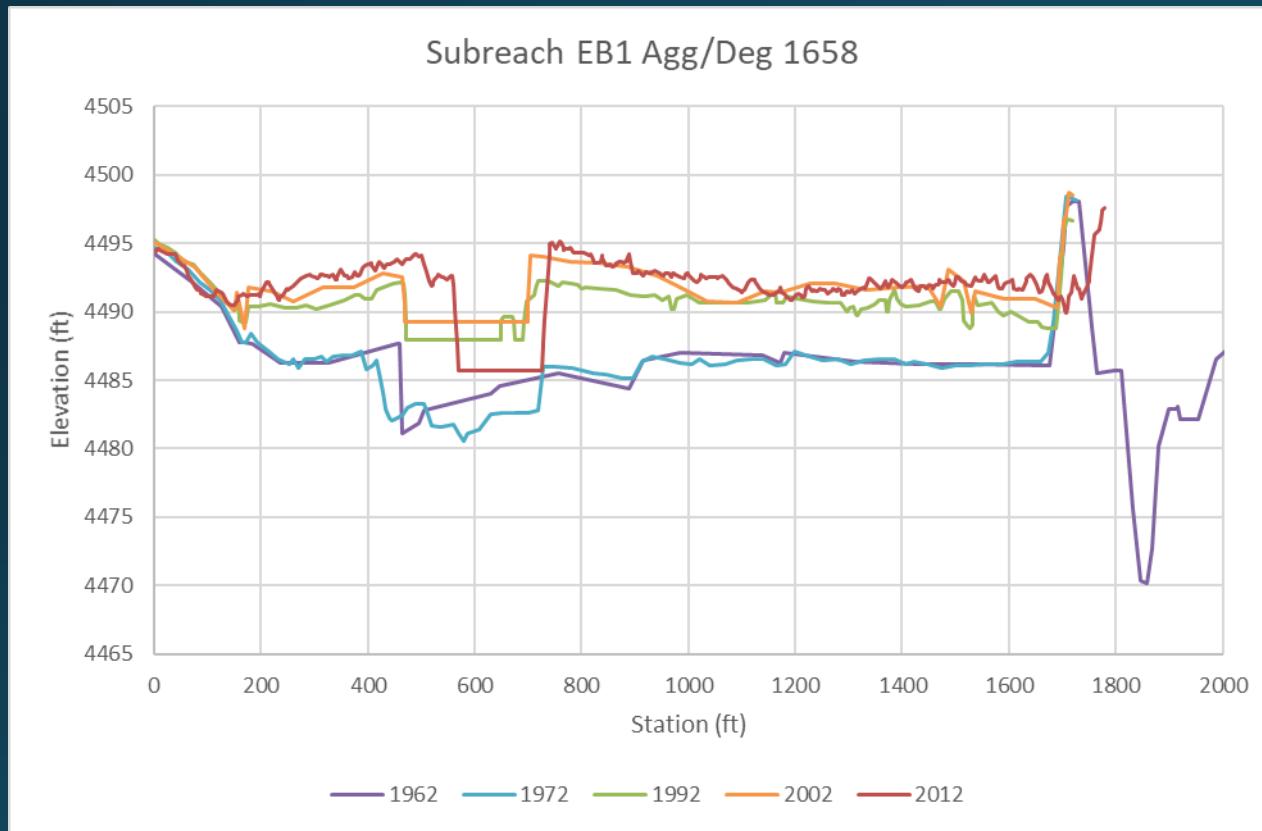
Conceptual Planform Model



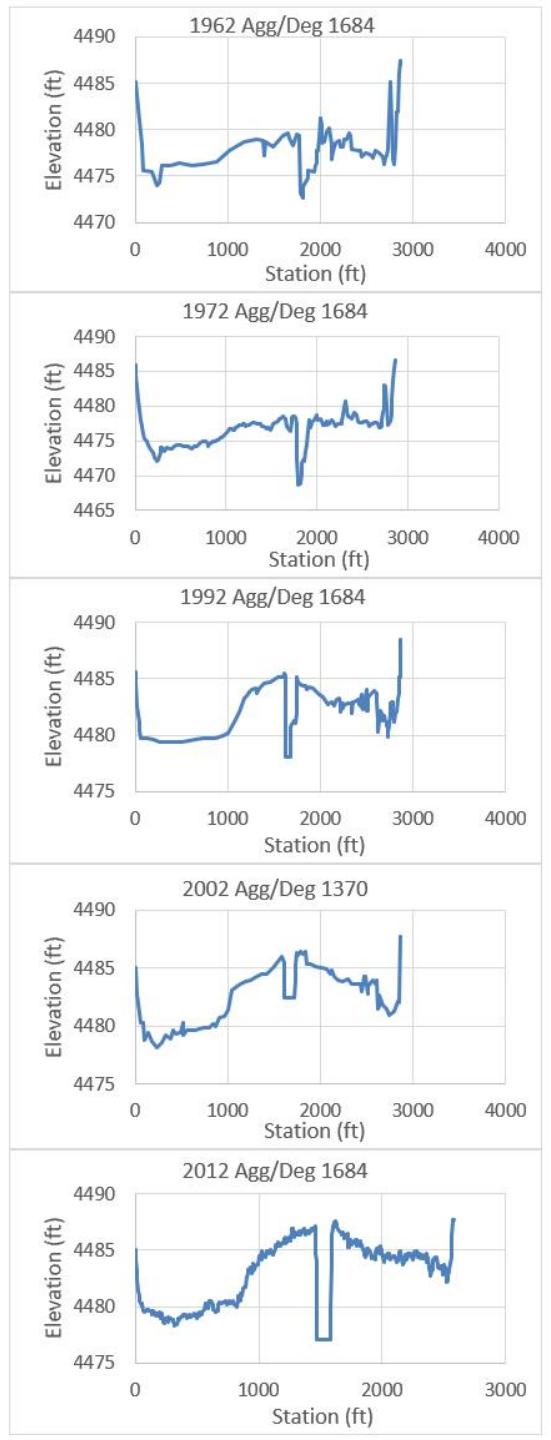
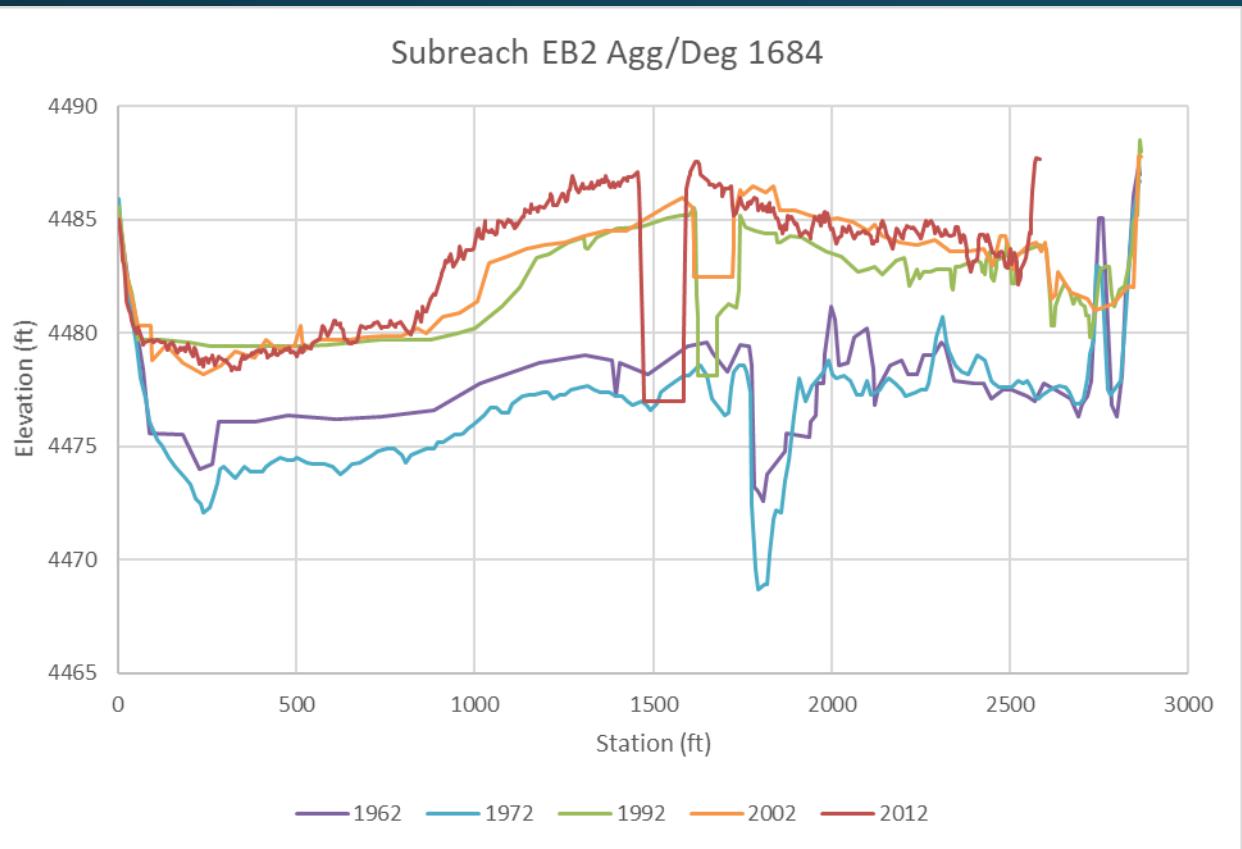
Planform evolution model from Massong et al. (2010). The river undergoes stages 1-3 first and then continues to stages A4-A6 or stages M4-M8 depending on the sediment transport capacity.

Rio's Cross-section in Subreach EB3, Agg/Deg 1714

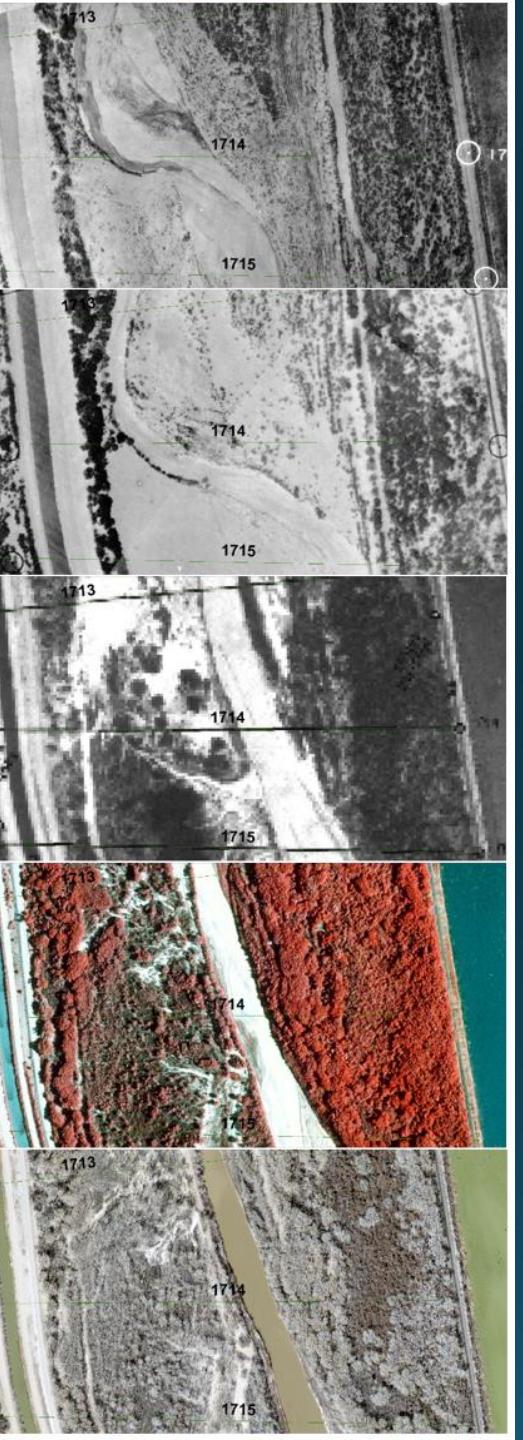
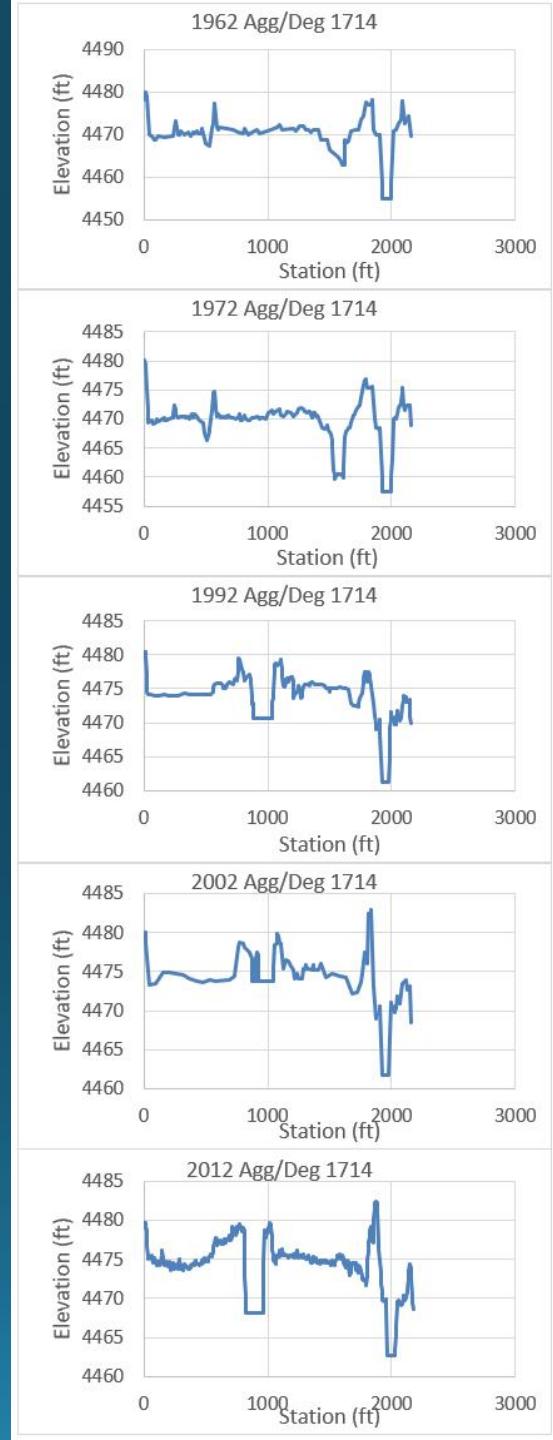
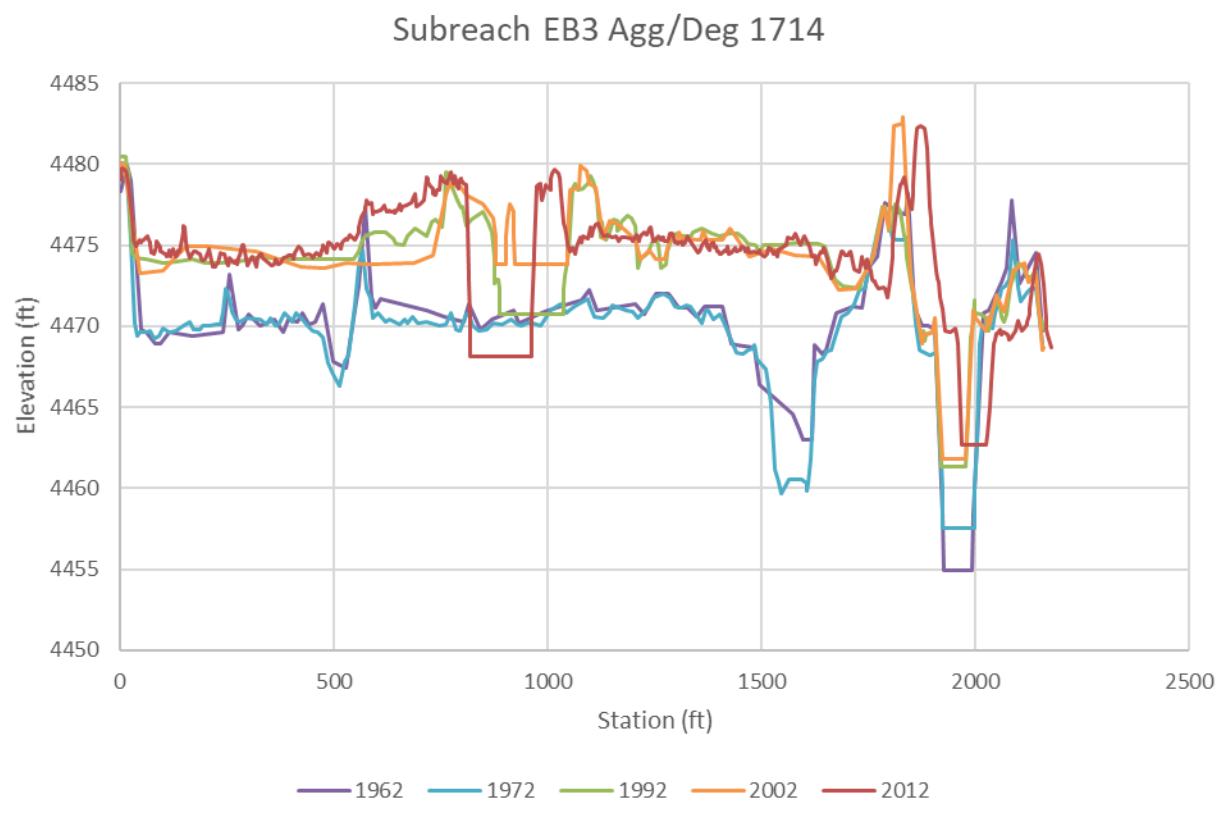
Subreach EB1



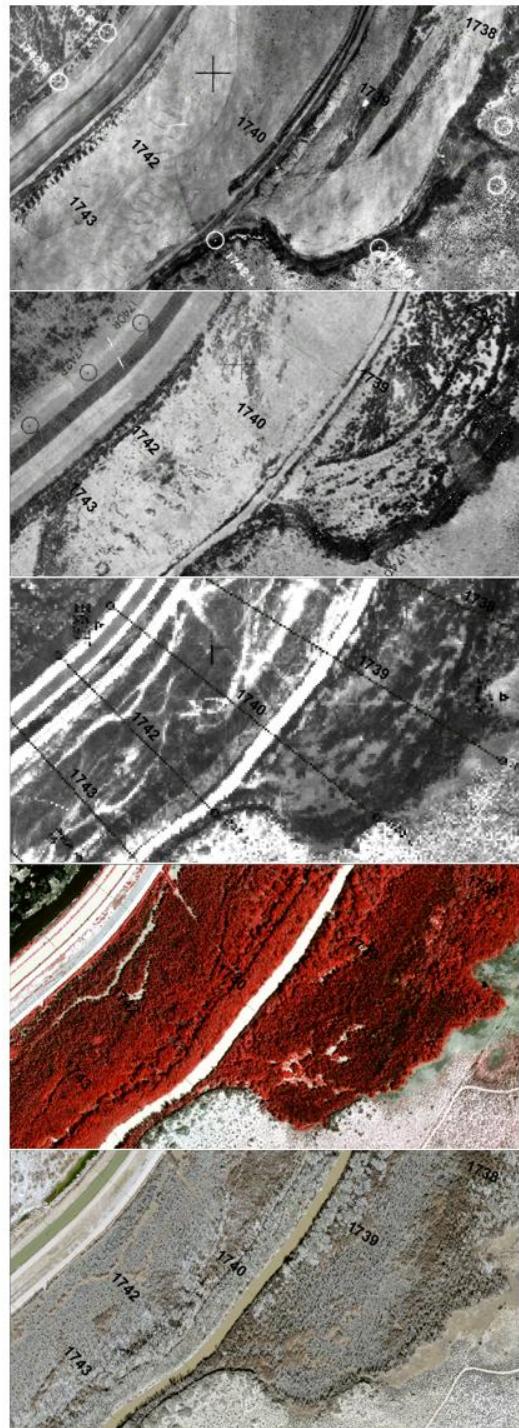
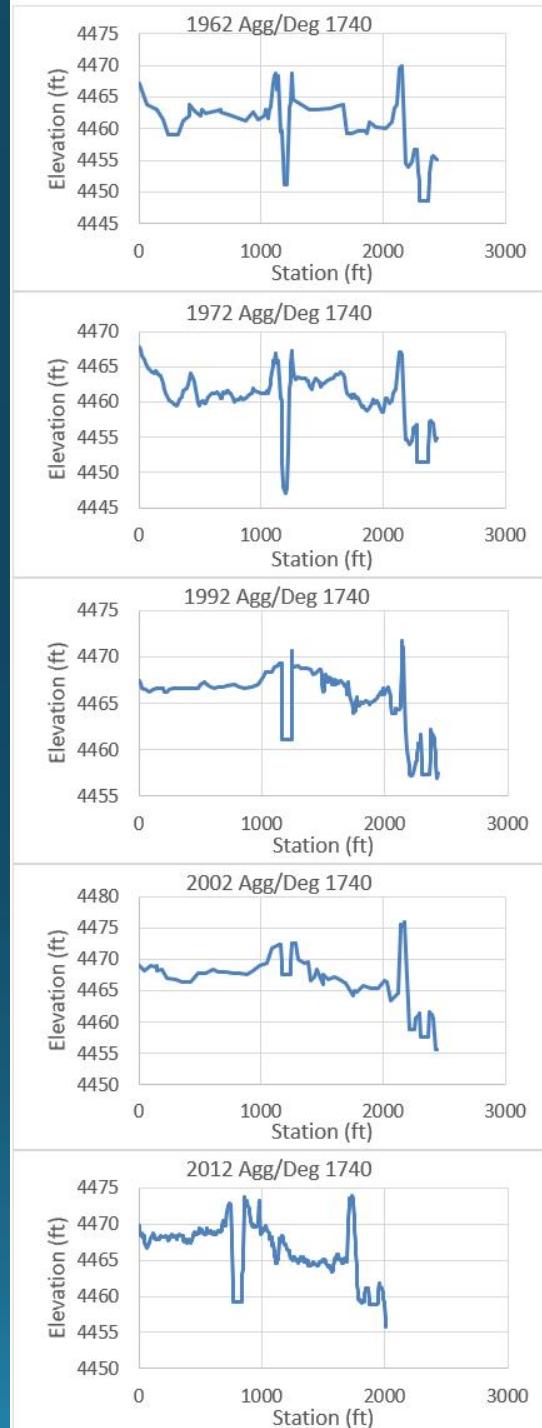
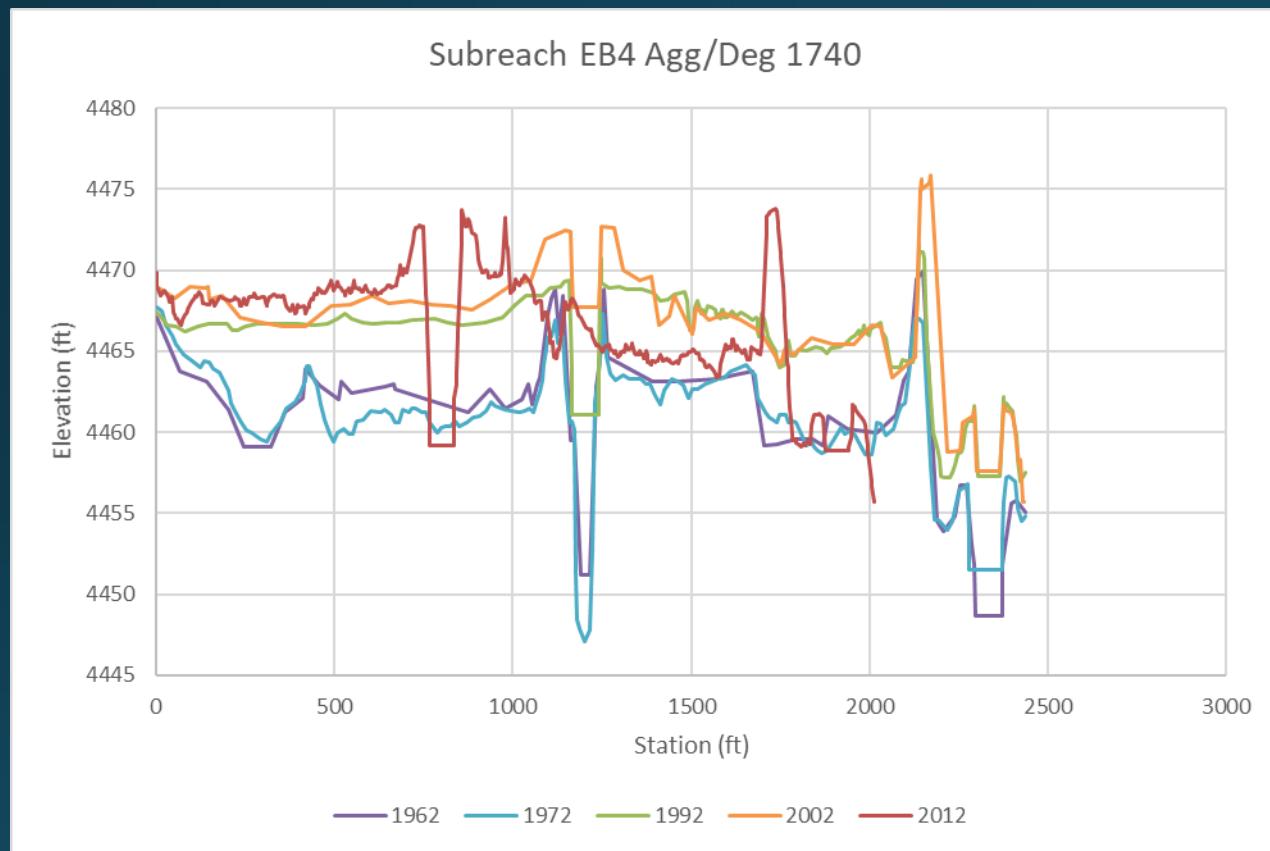
Subreach EB2



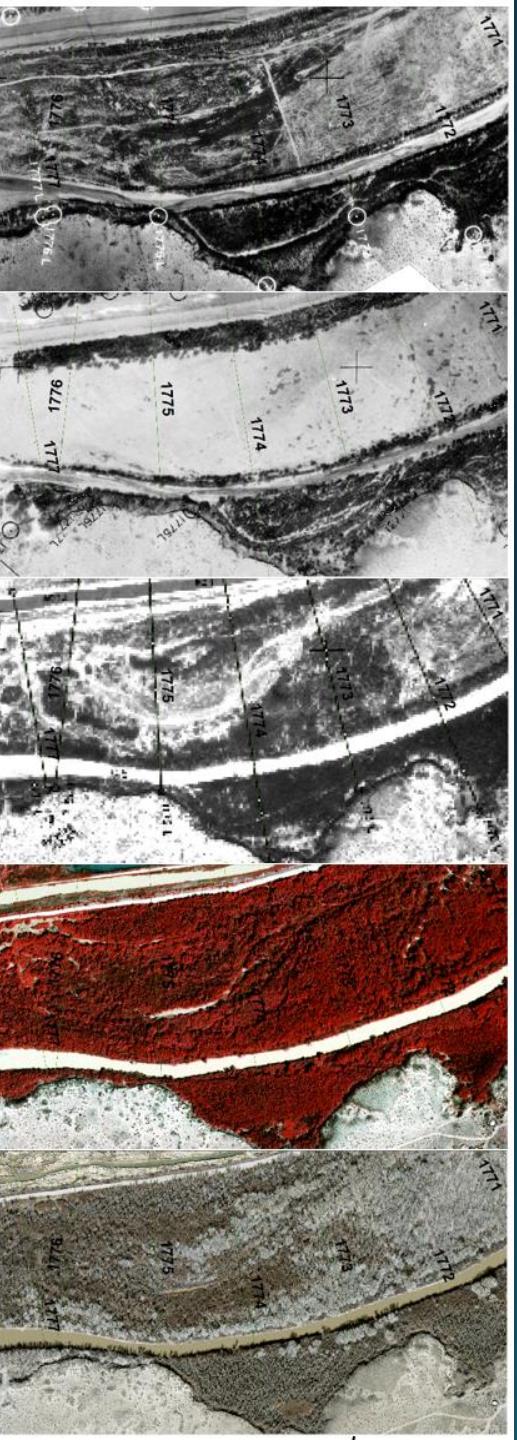
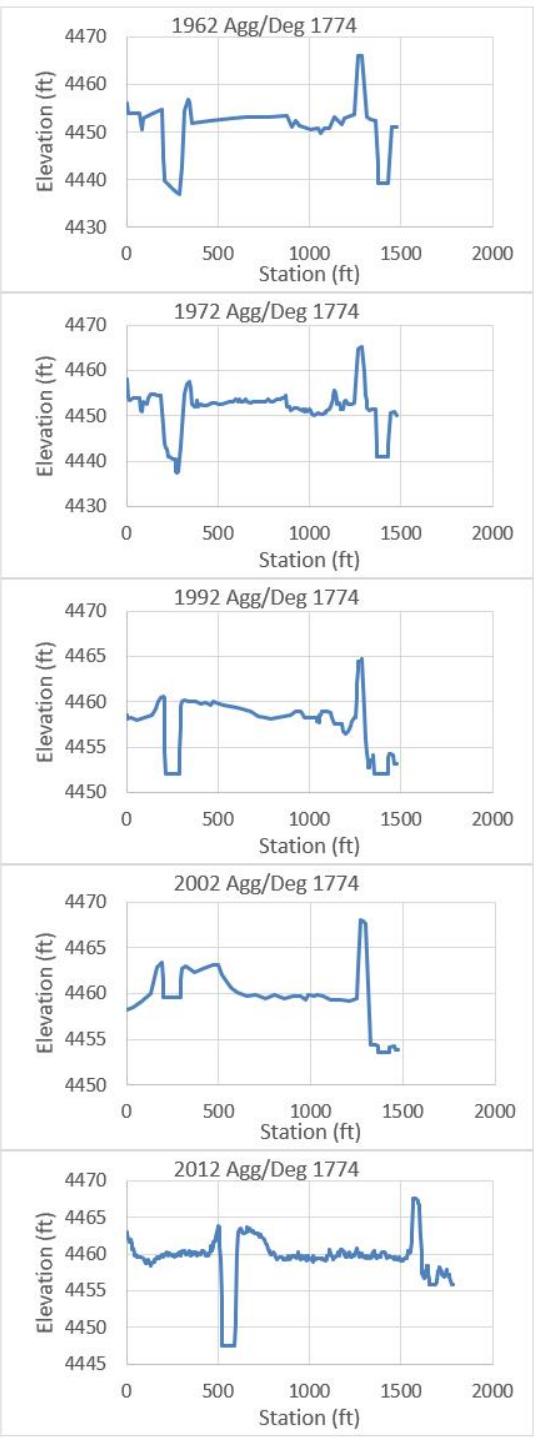
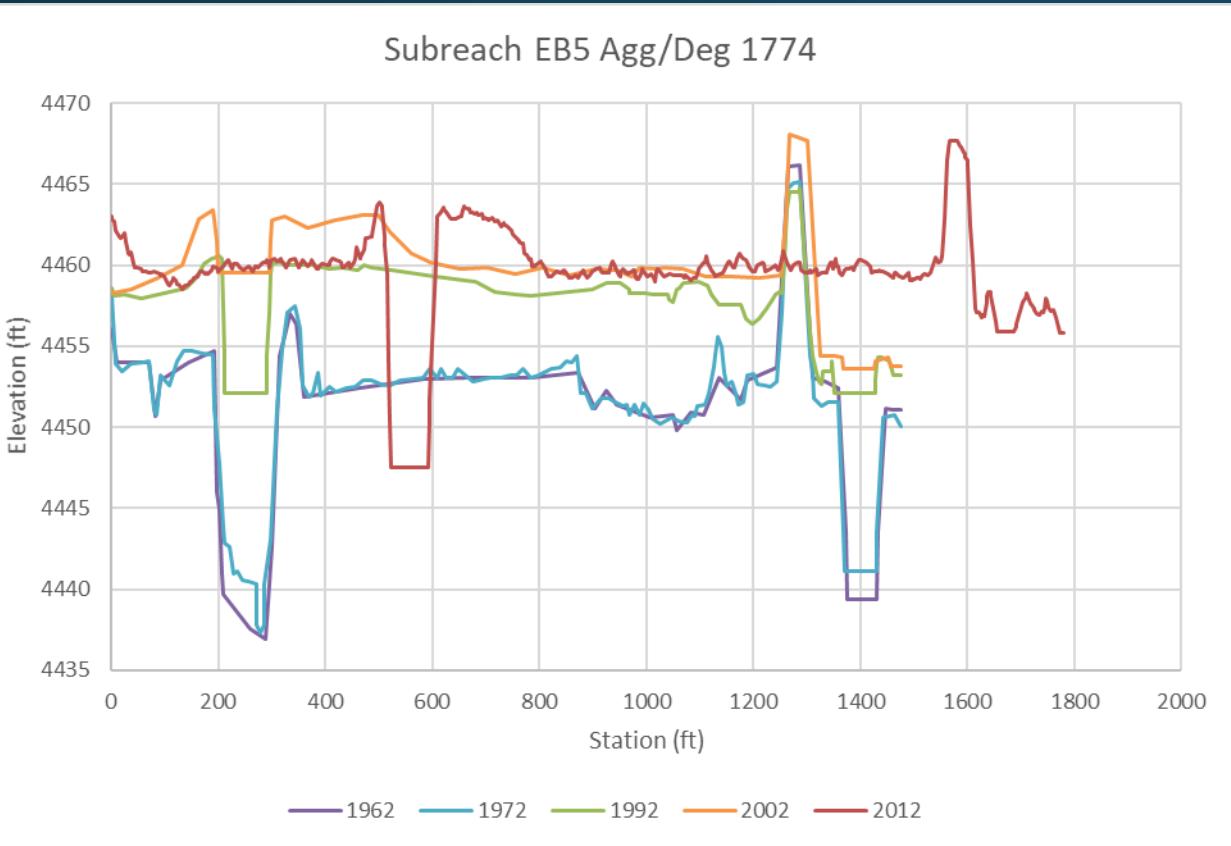
Subreach EB3



Subreach EB4

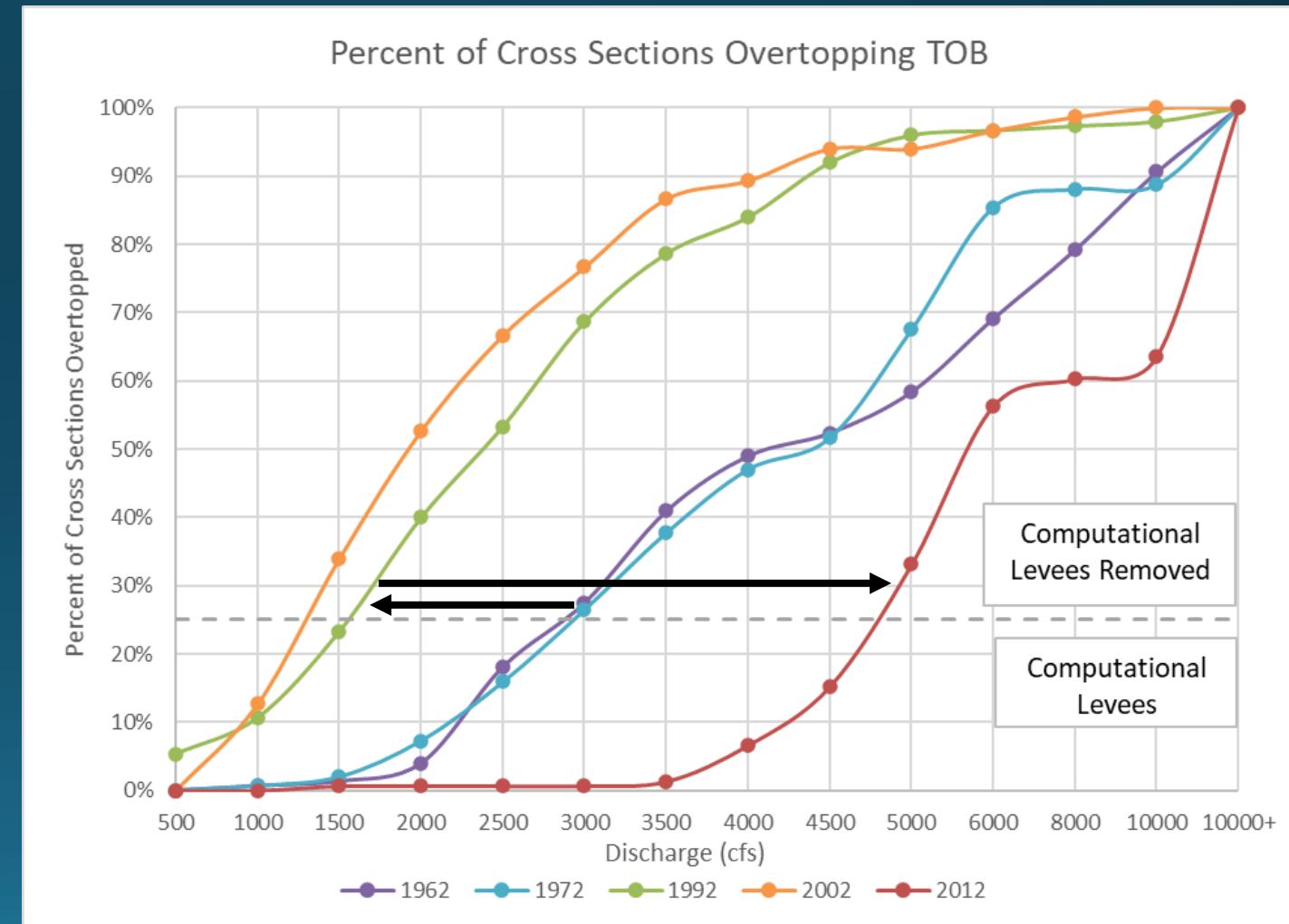


Subreach EB5



Percent Overtopping

- Due to aggradation degradation cycles over topping has required different cfs
- Potentially takes 4,750 cfs or more for overtopping



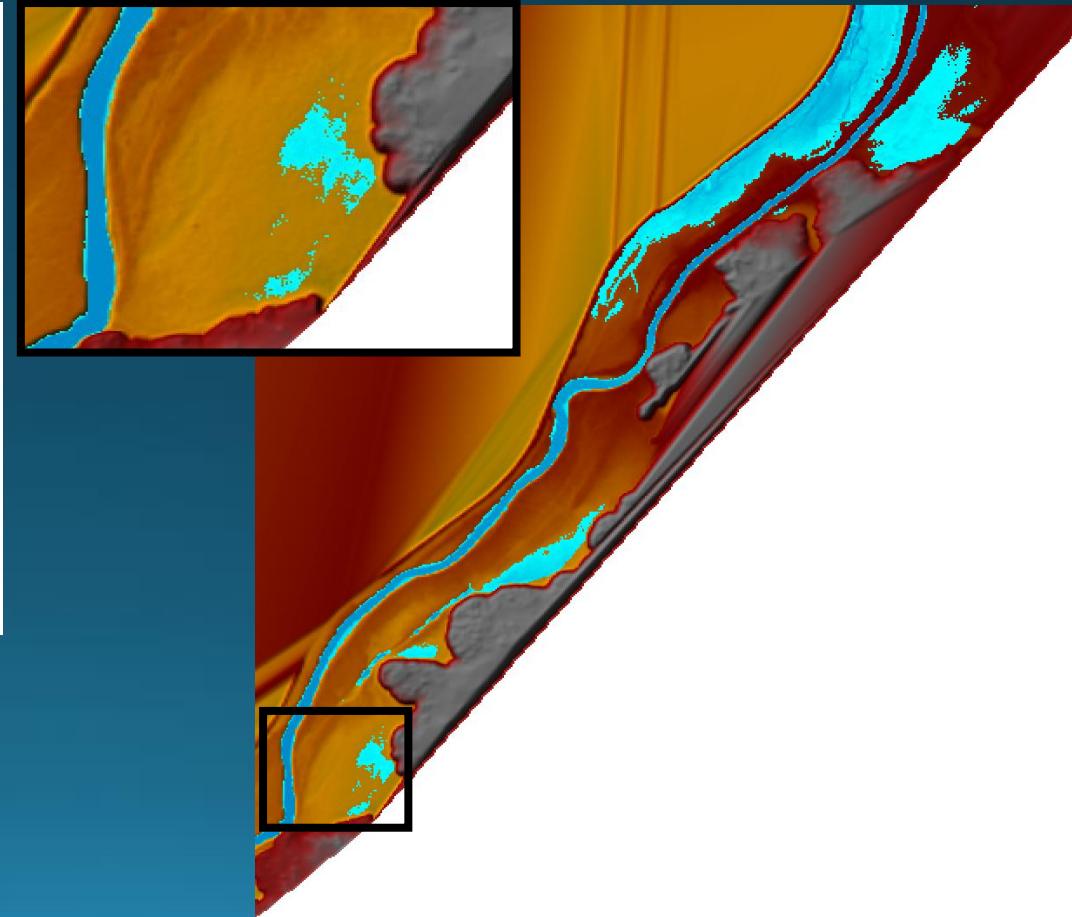
Current Problems

Sediment Plugging

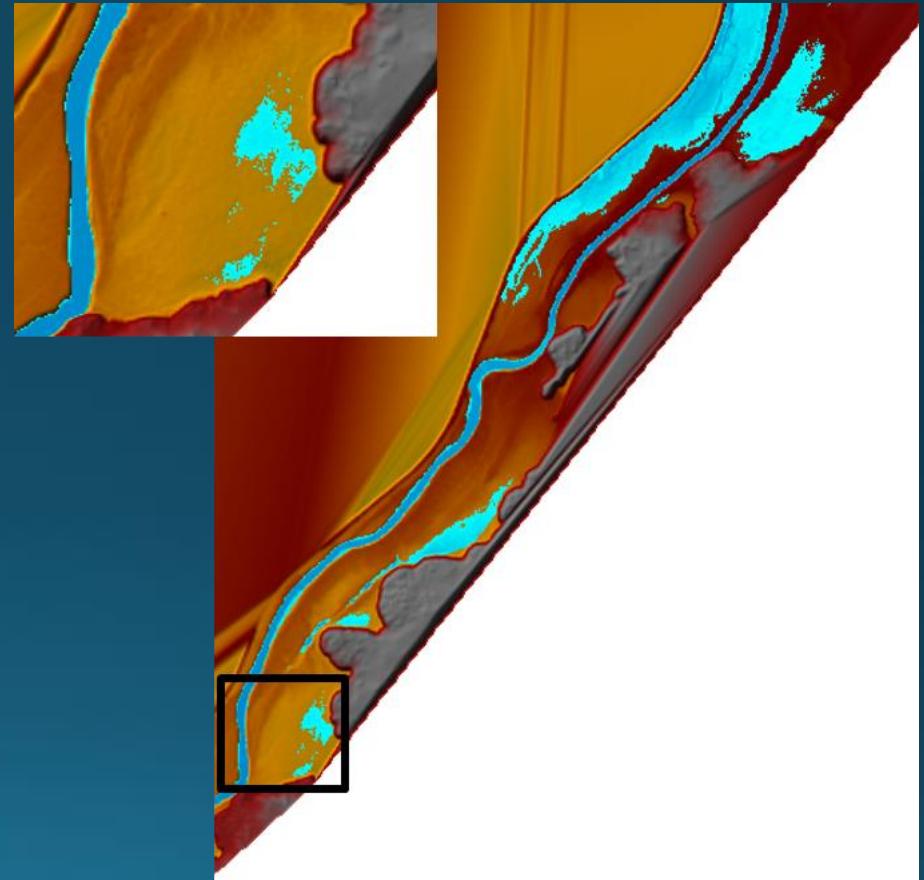
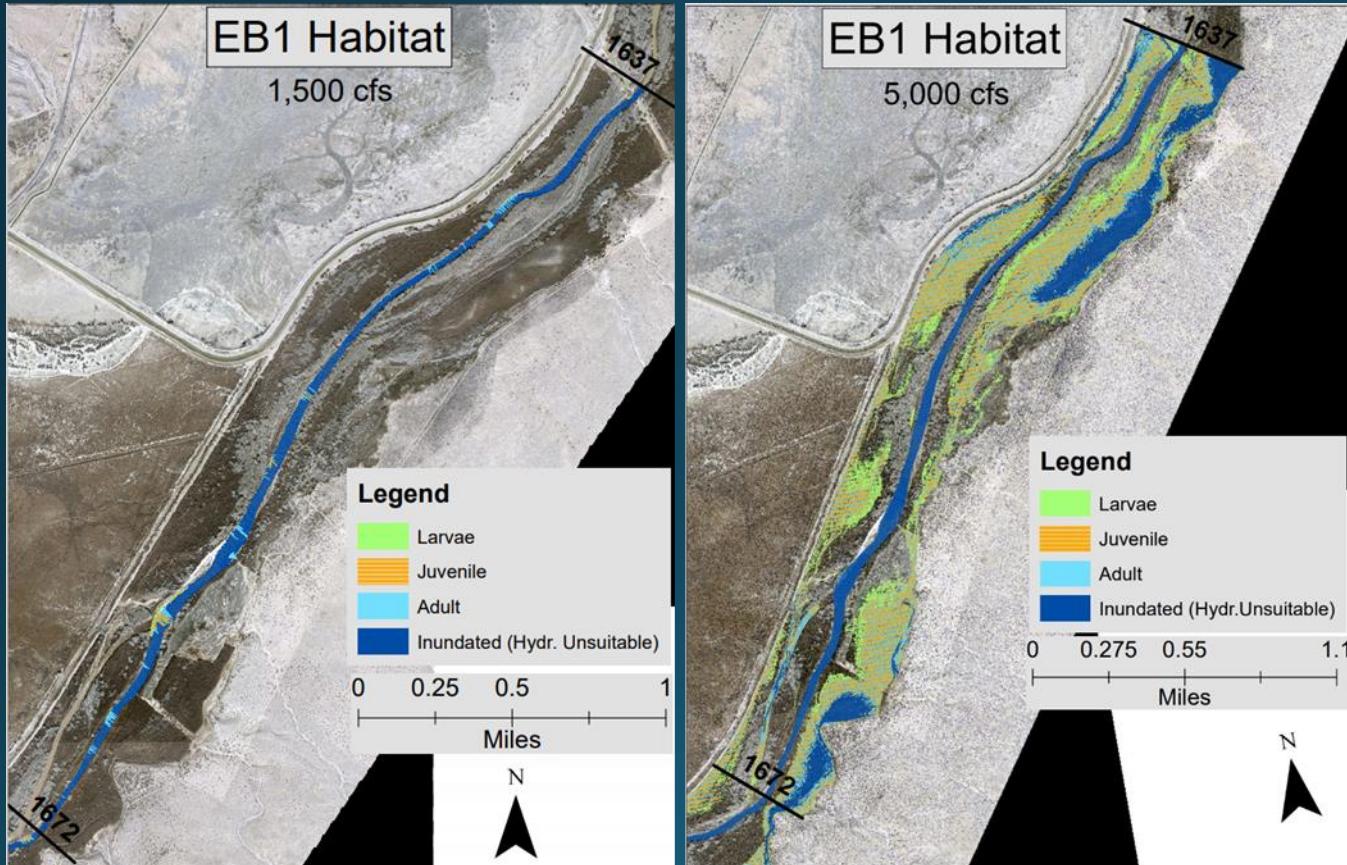


Downstream view of the 2005 Tiffany Plug (Owen et al., 2011)

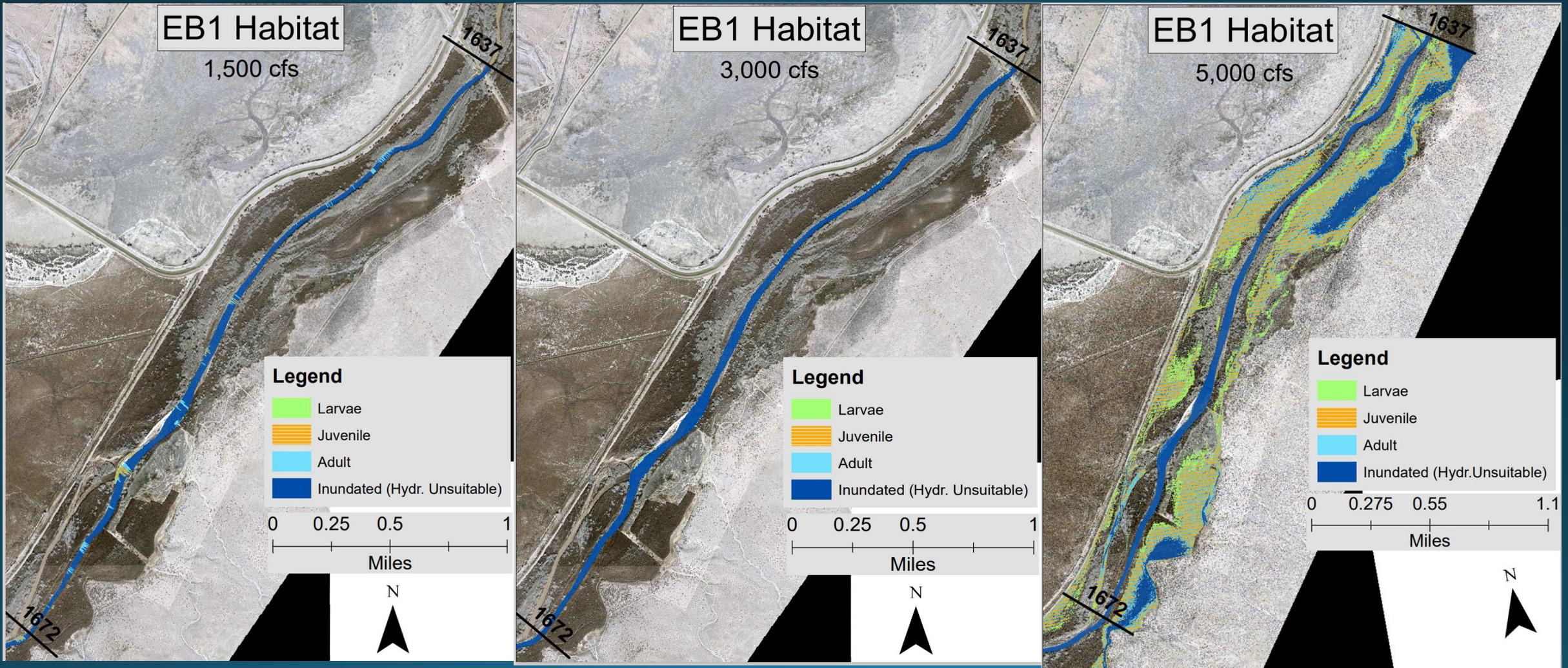
Disconnected Habitat



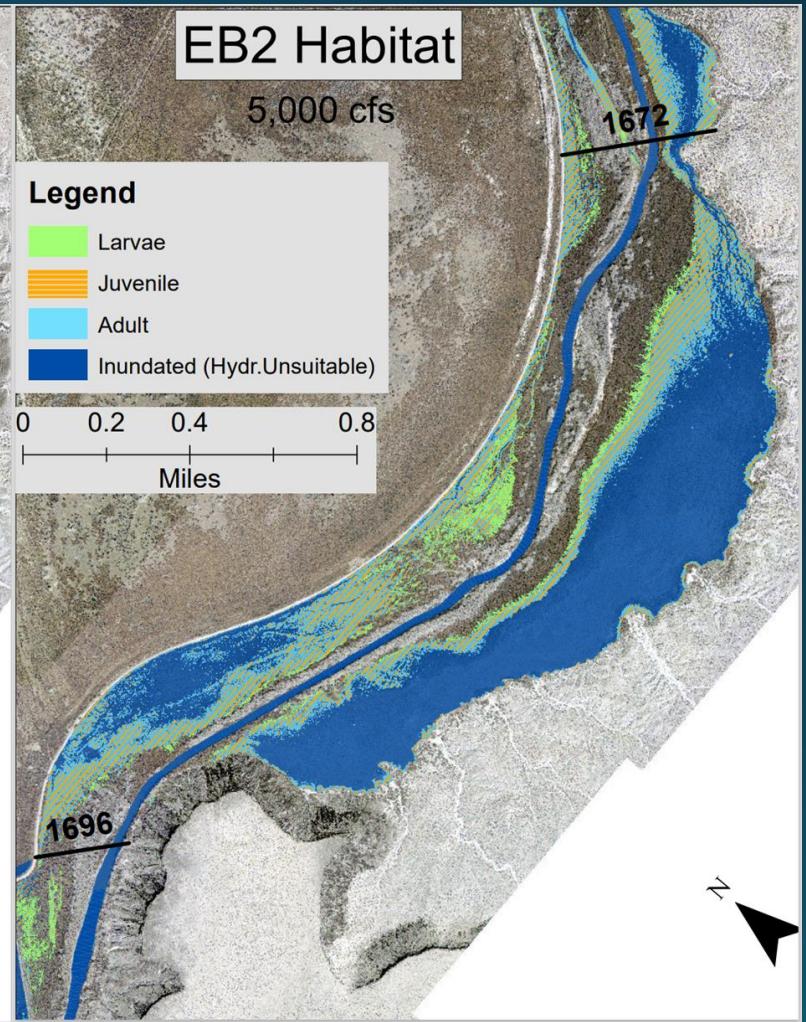
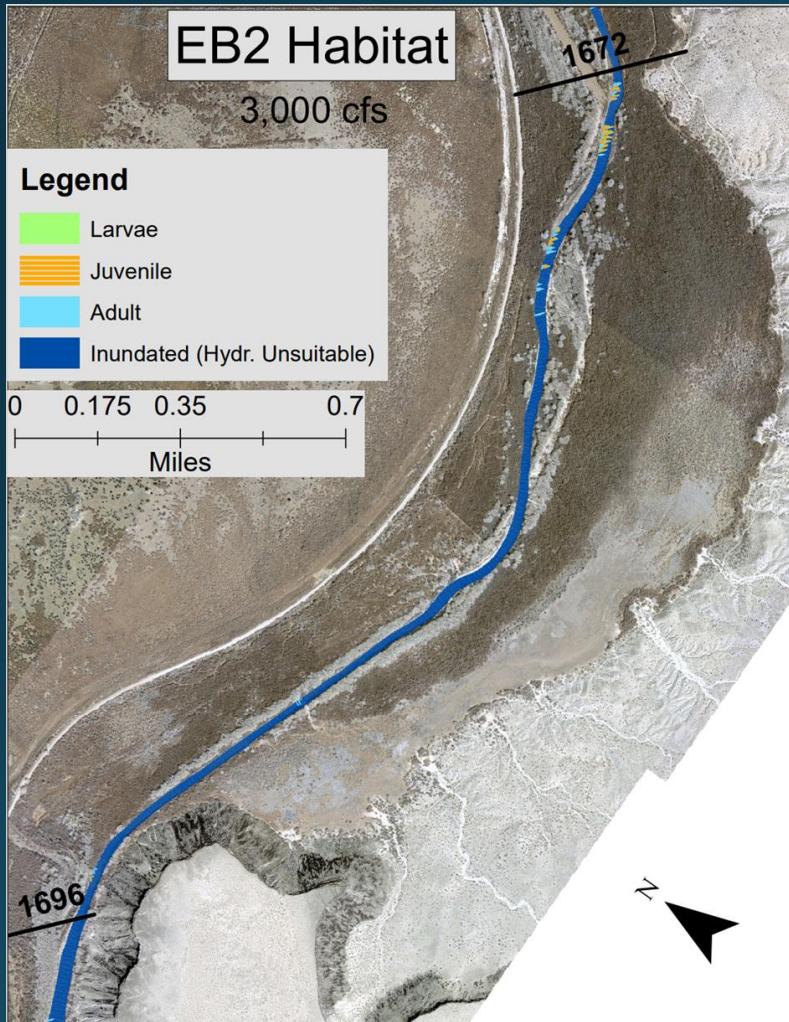
Disconnected Habitat



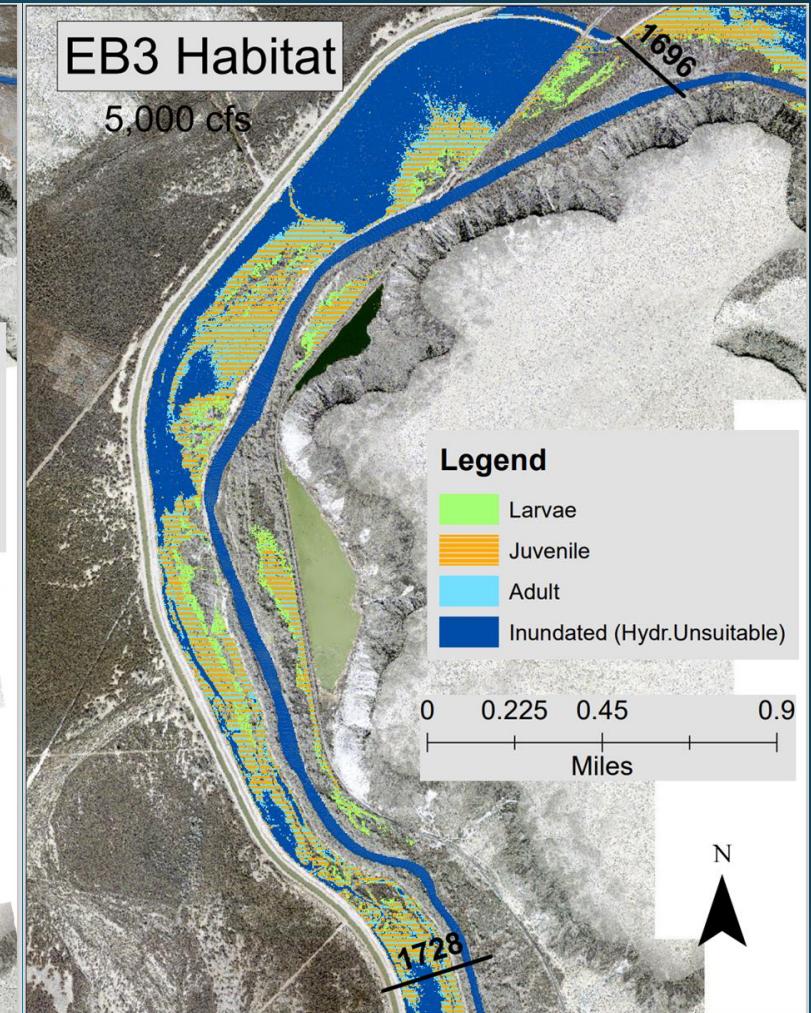
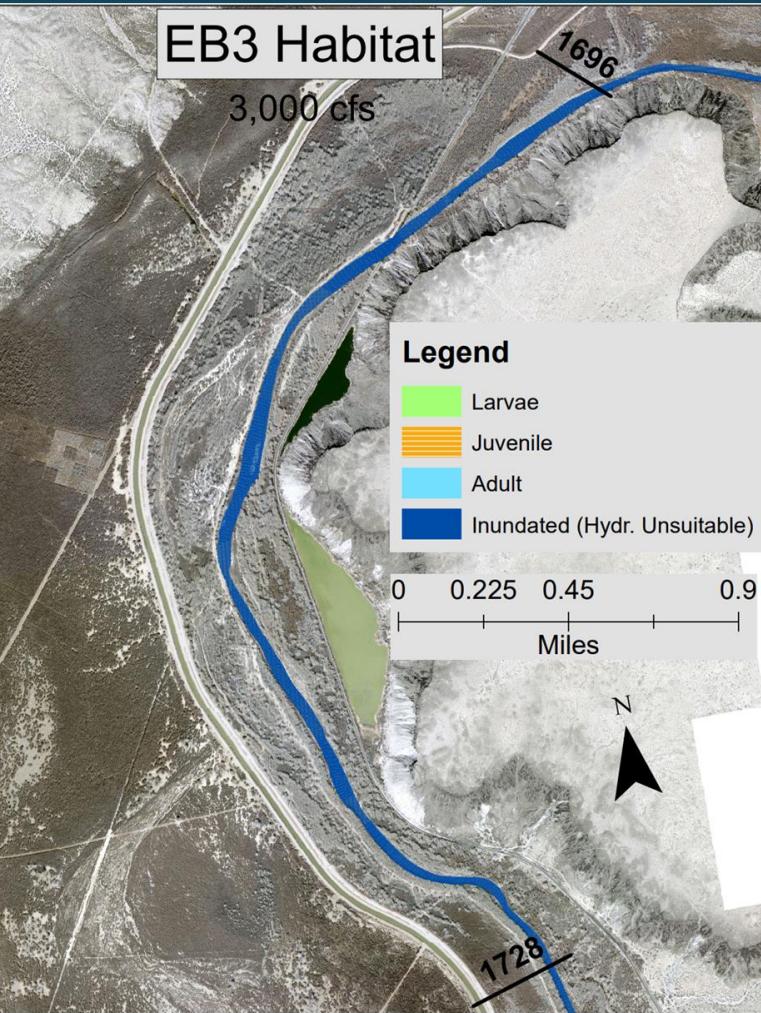
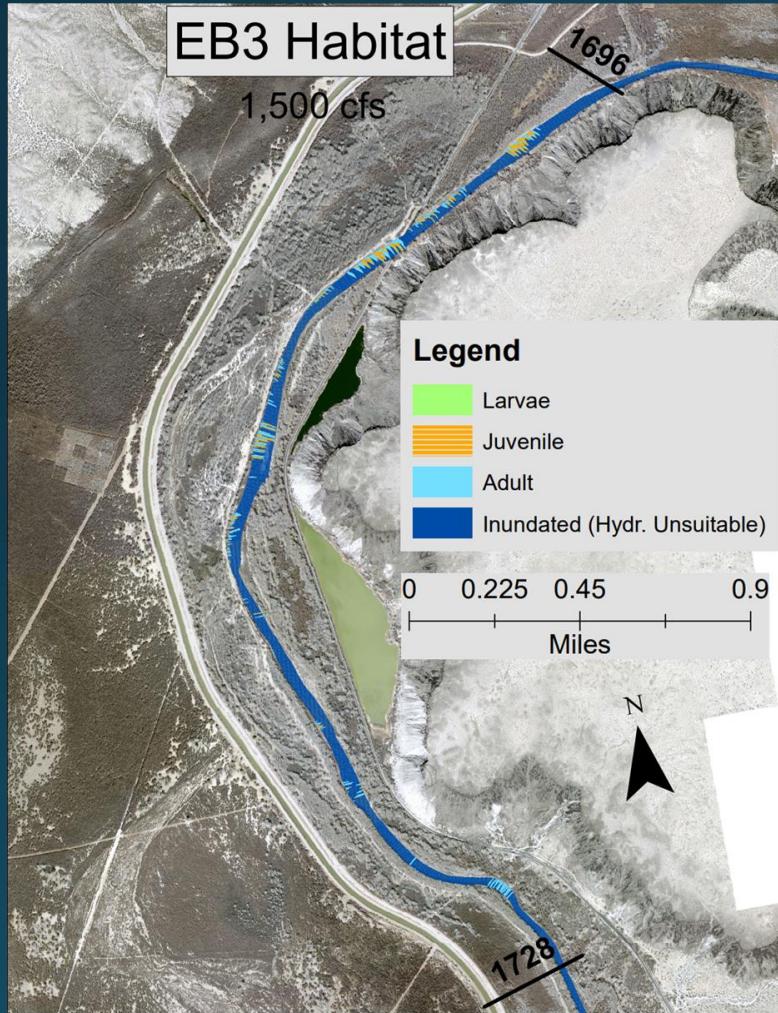
Subreach EB1



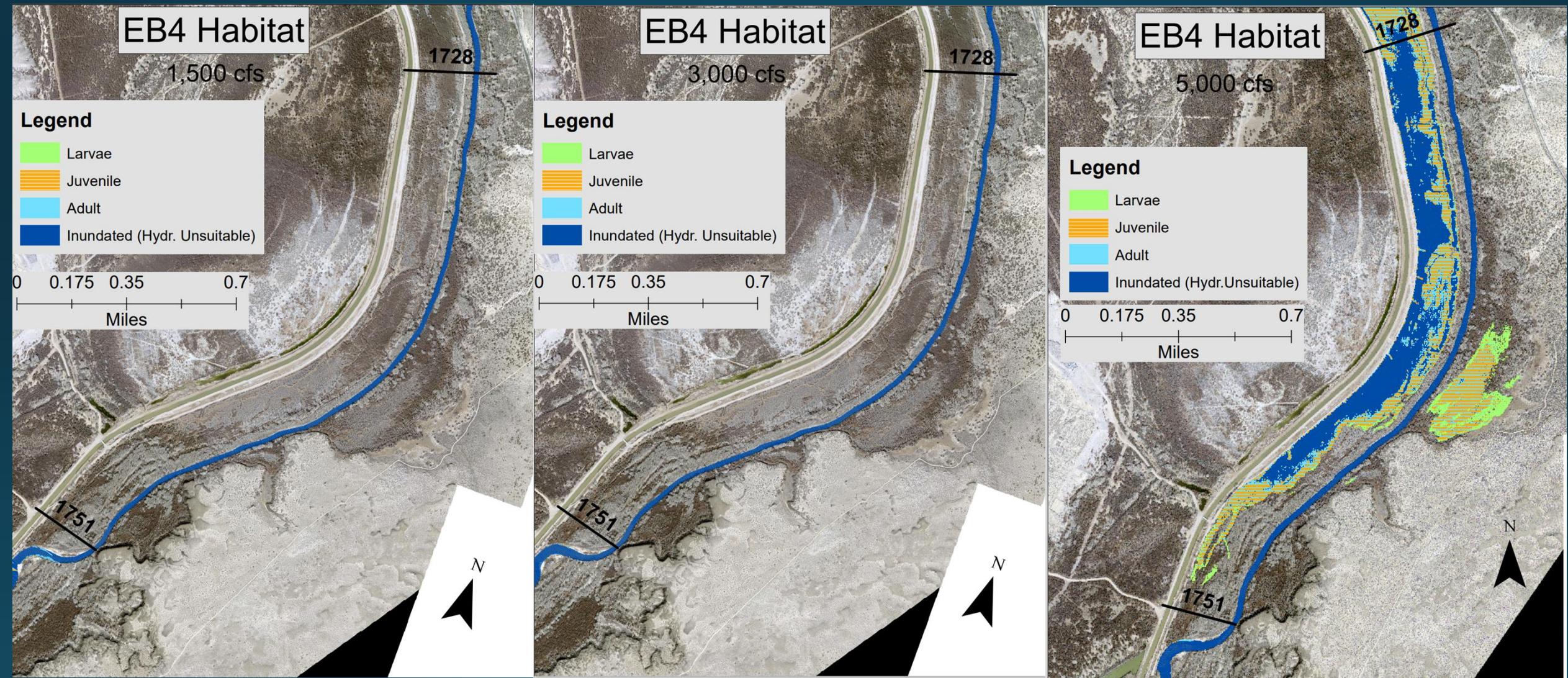
Subreach EB2



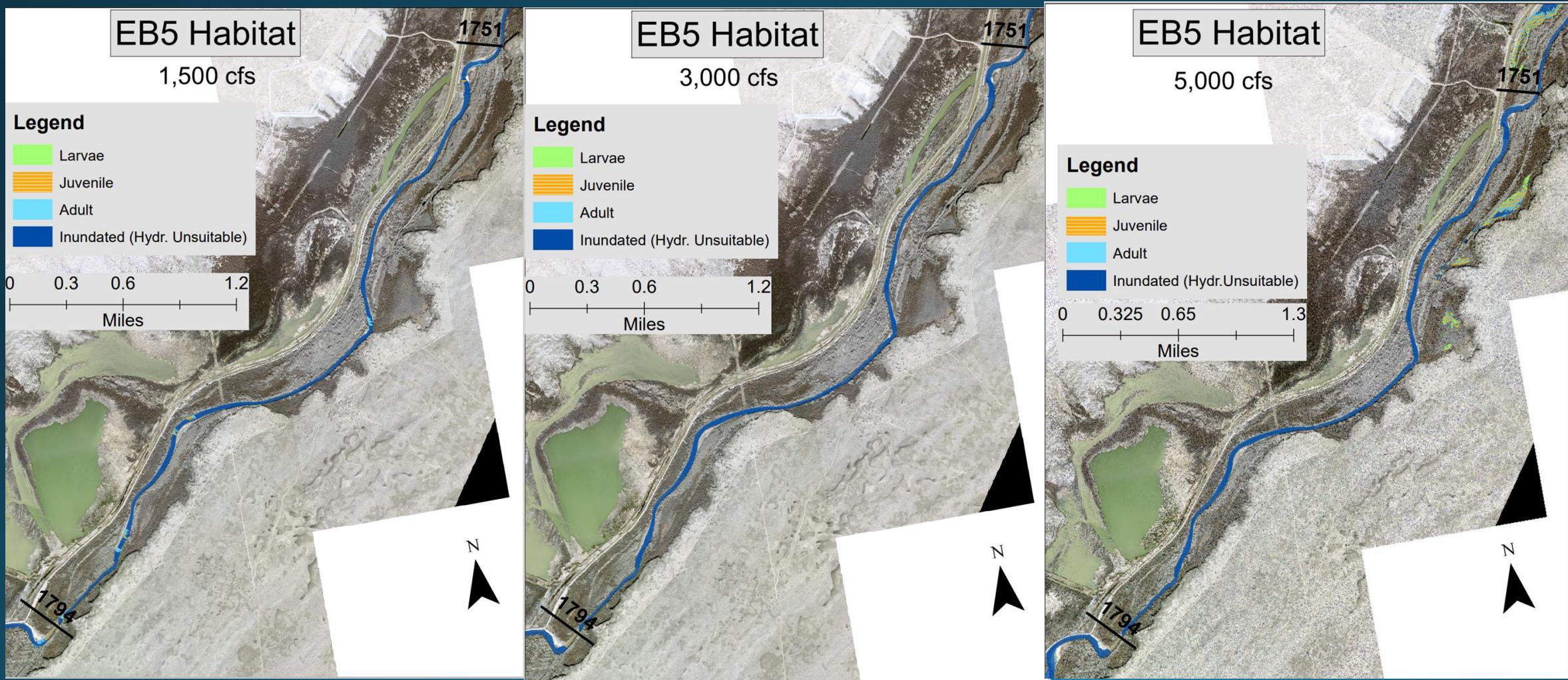
Subreach EB3



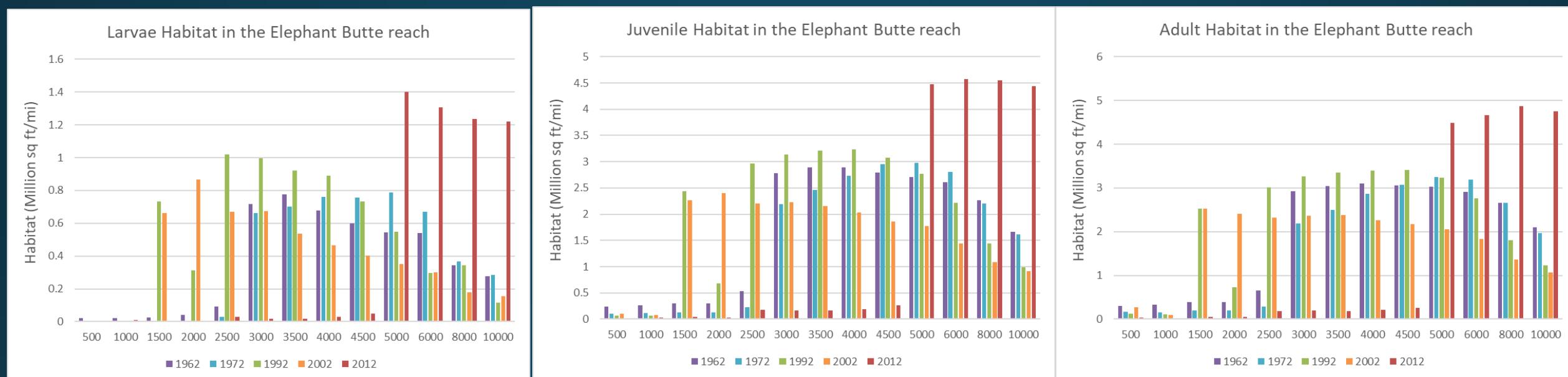
Subreach EB4



Subreach EB5

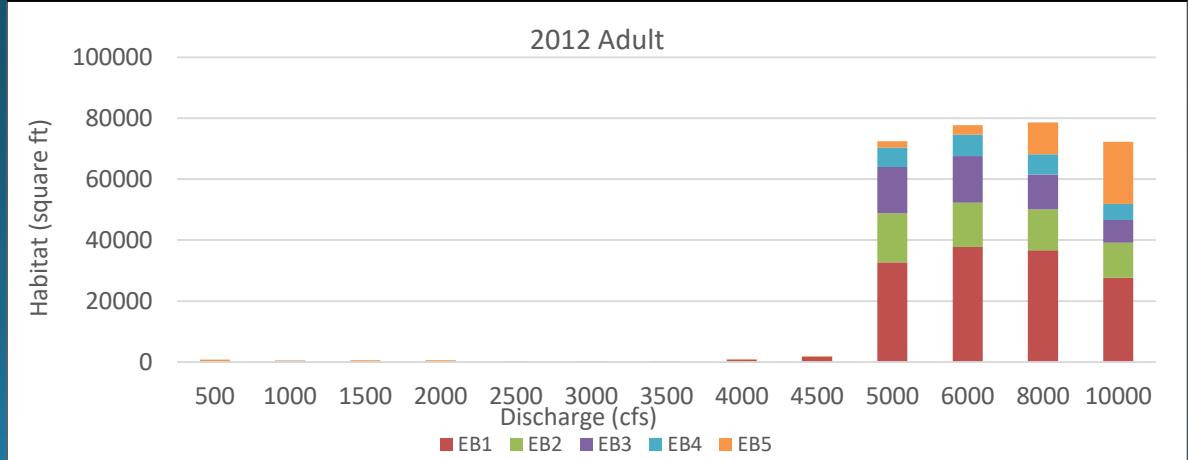
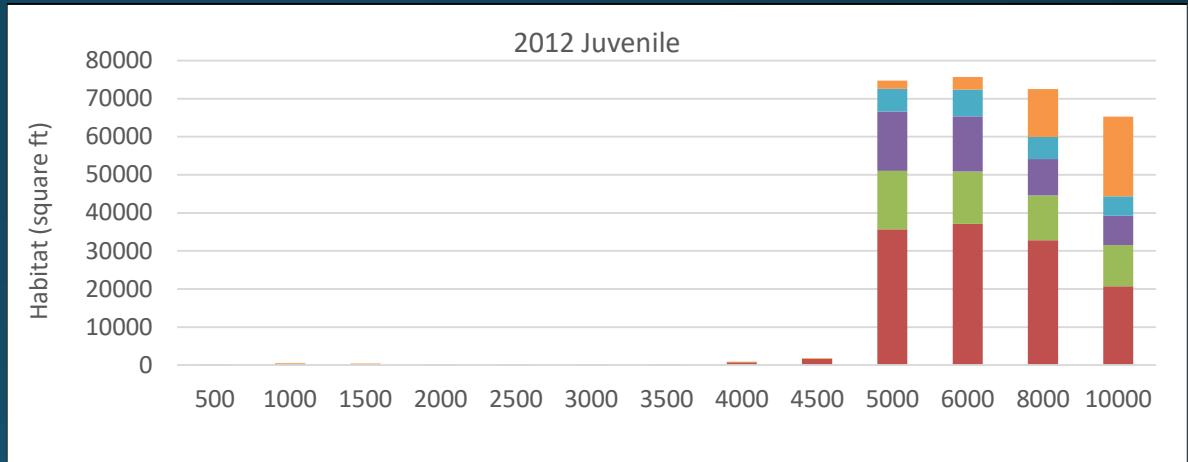
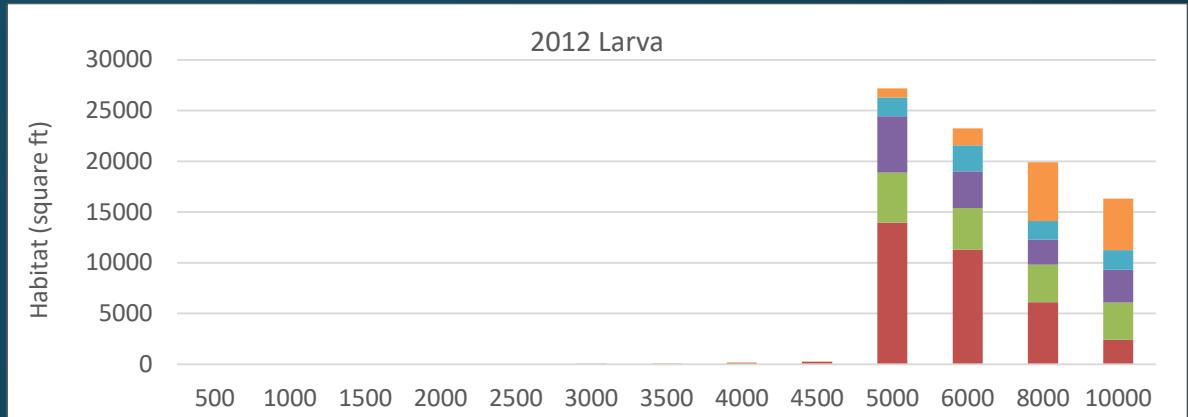
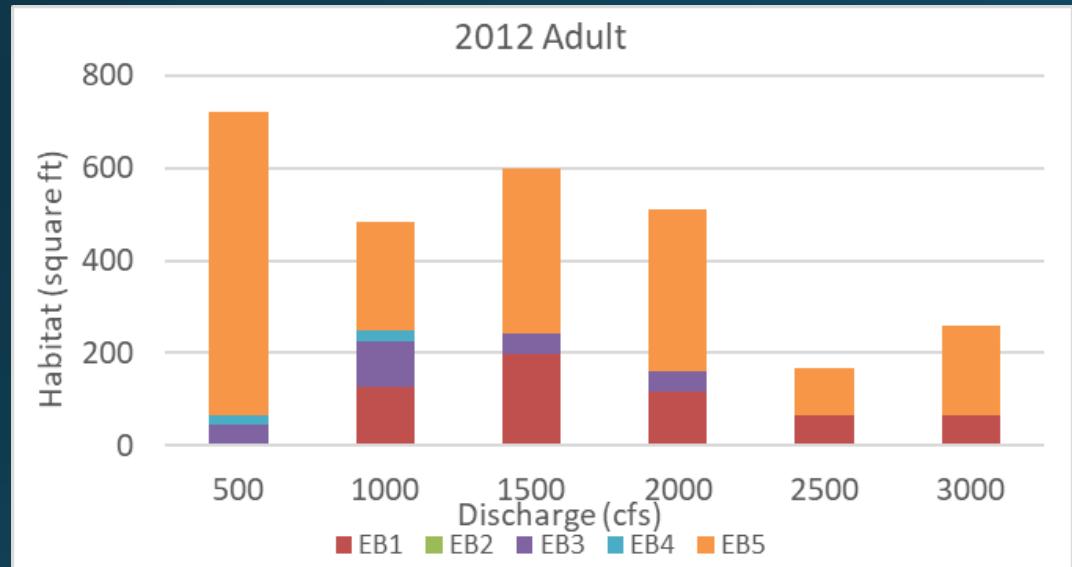


Habitat Availability

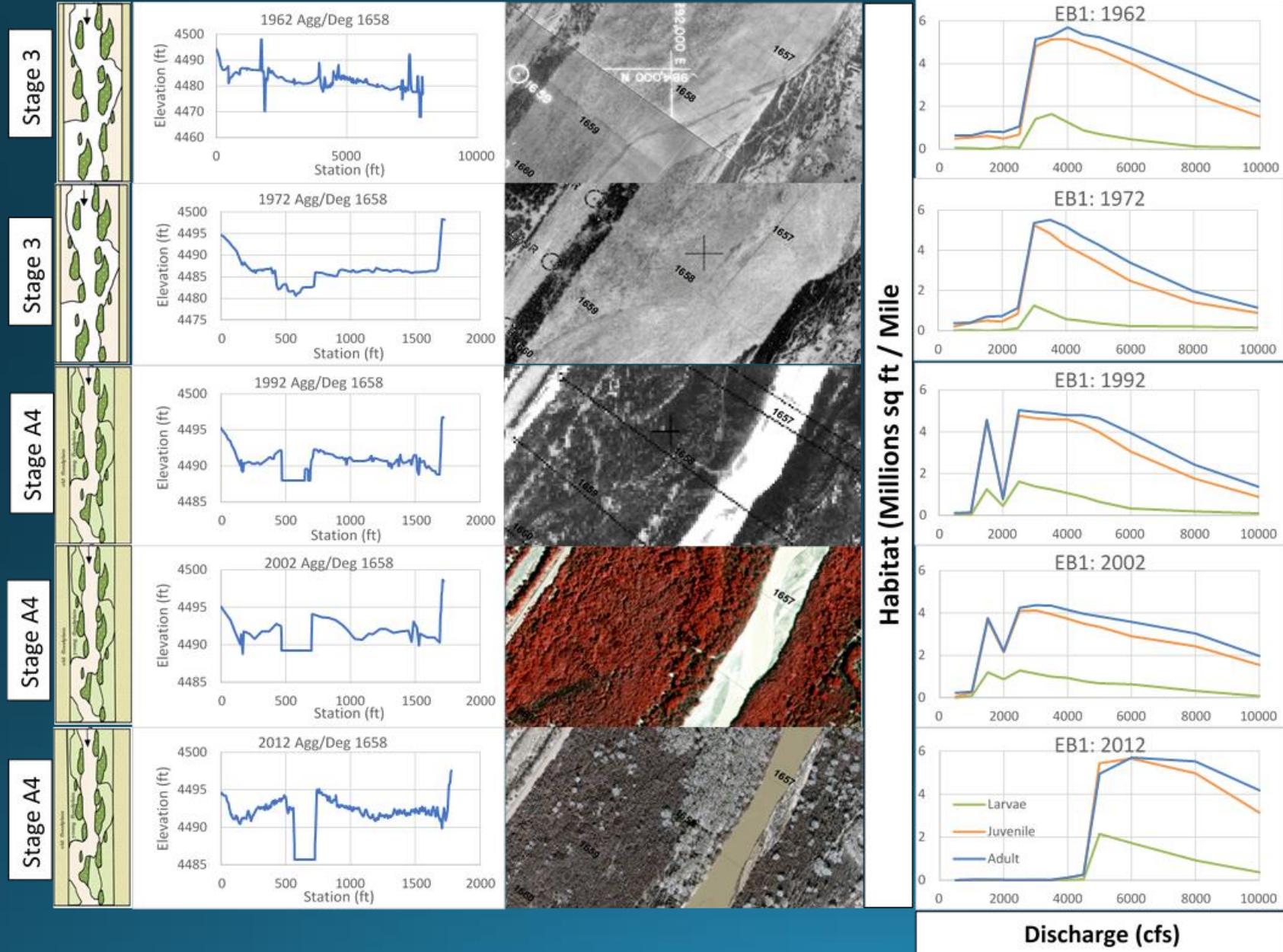


- Takes up to 4,750 cfs to over top in some locations (Subreach EB5)
- 2012 includes subreach EB6

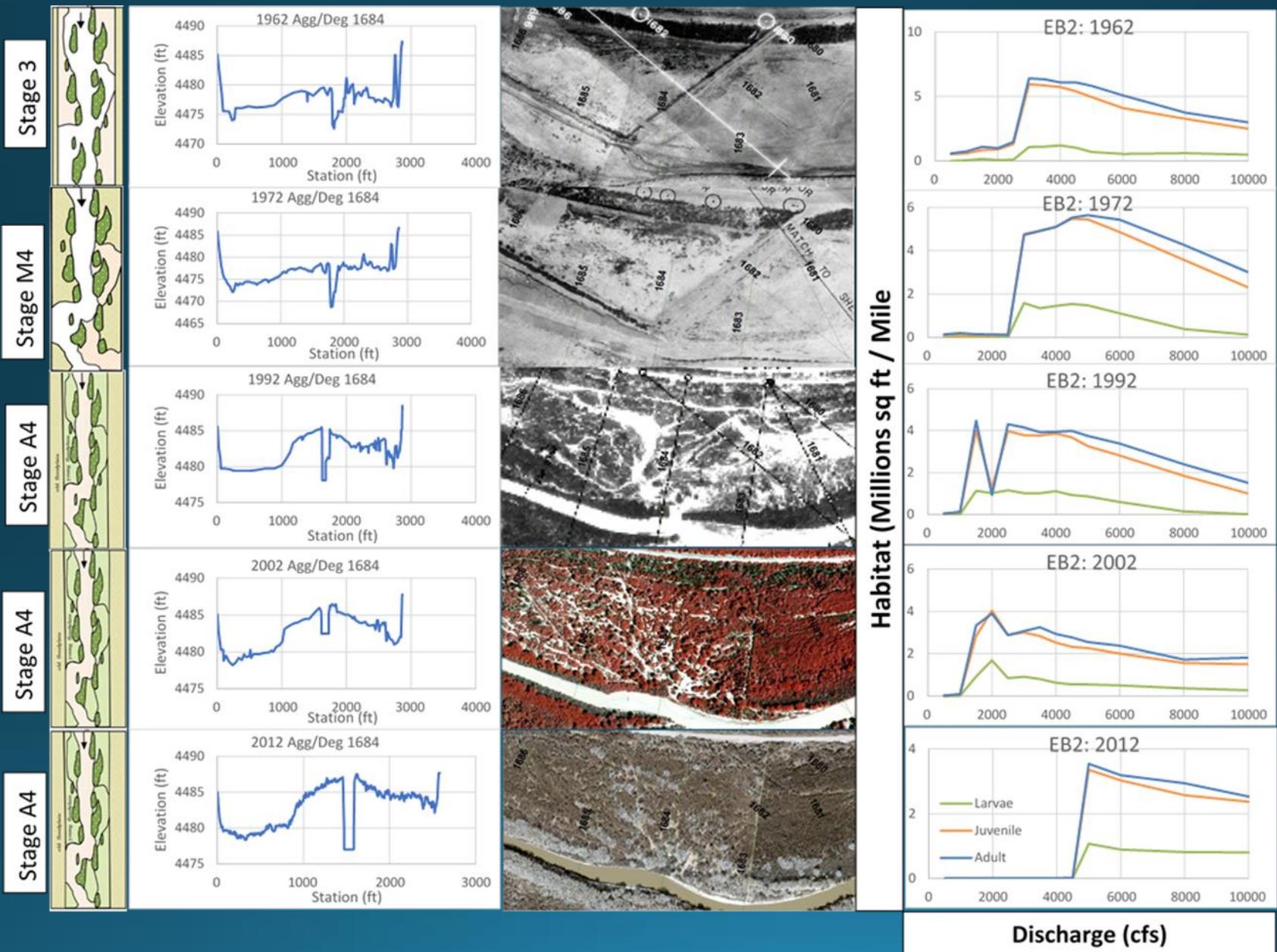
2012 Breakdown



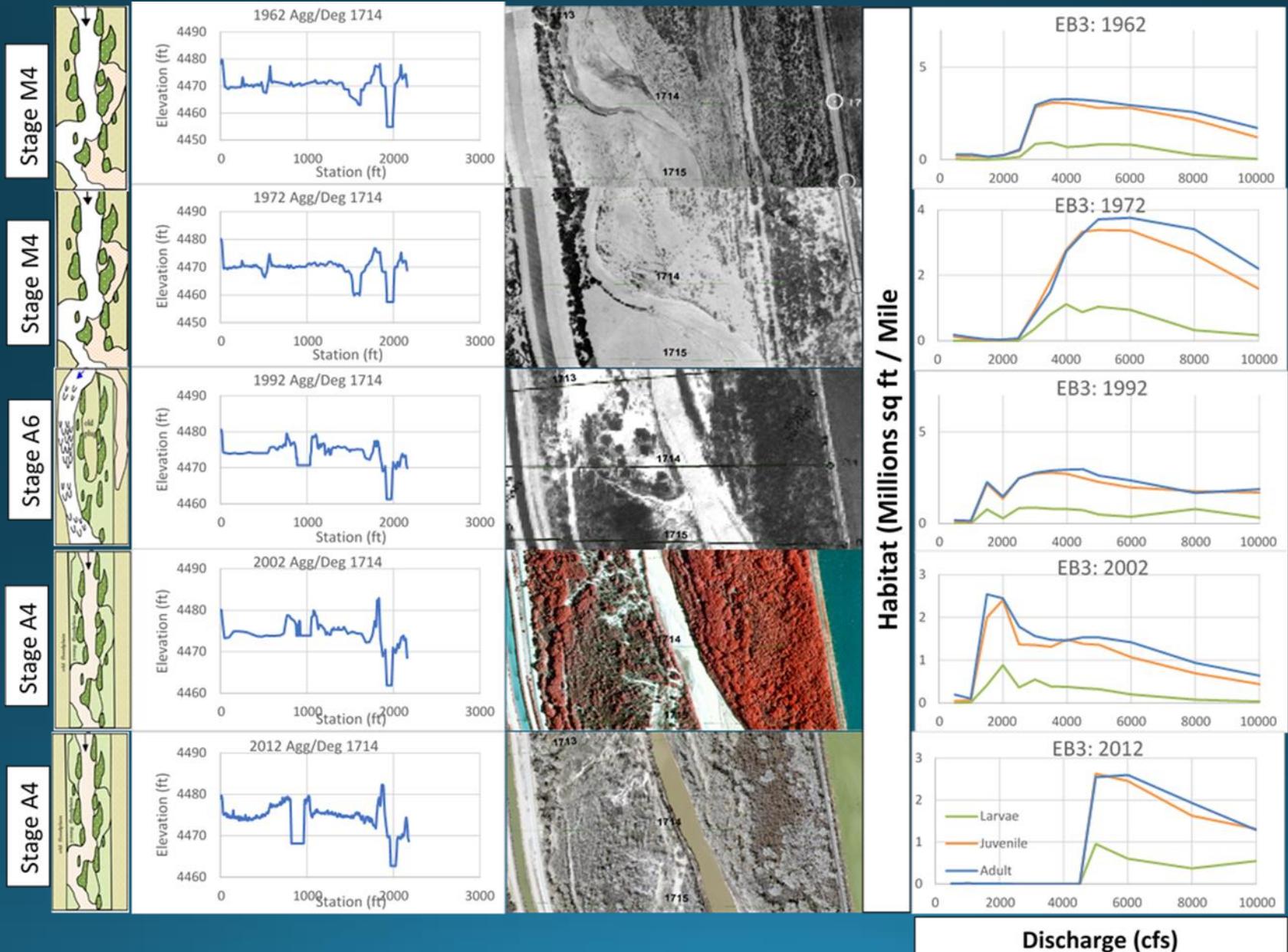
Subreach EB1



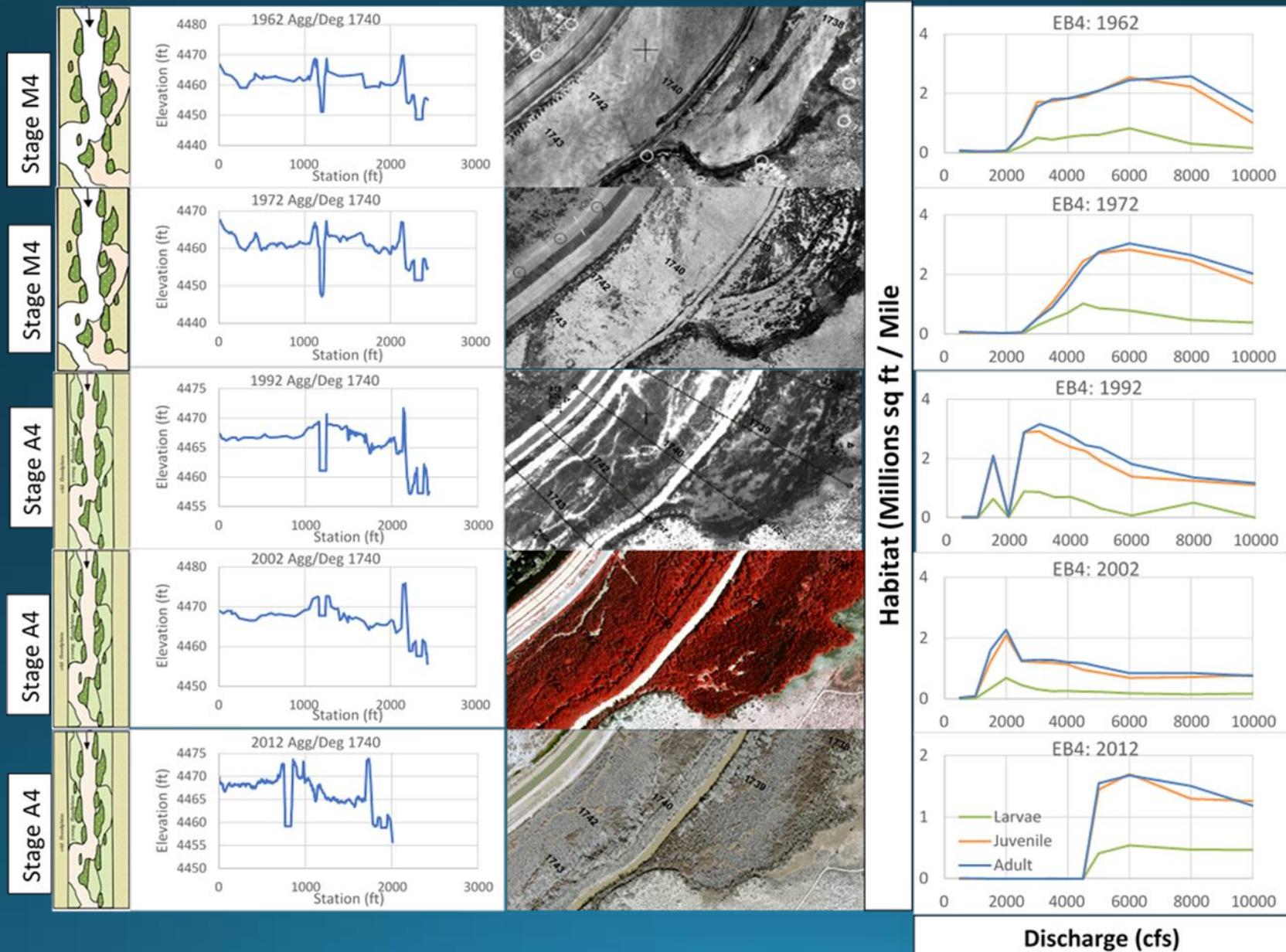
Subreach EB2



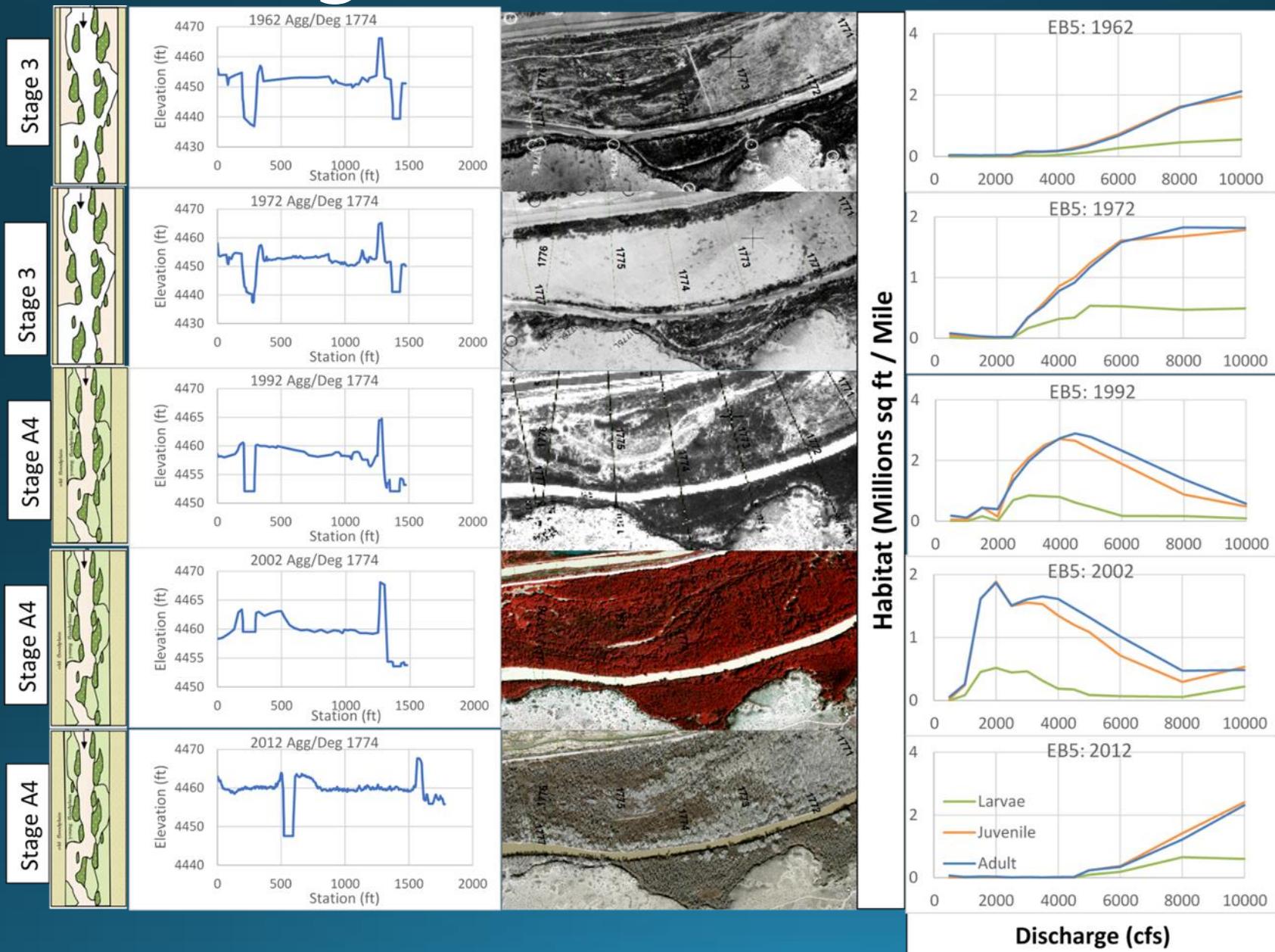
Subreach EB3



Subreach EB4



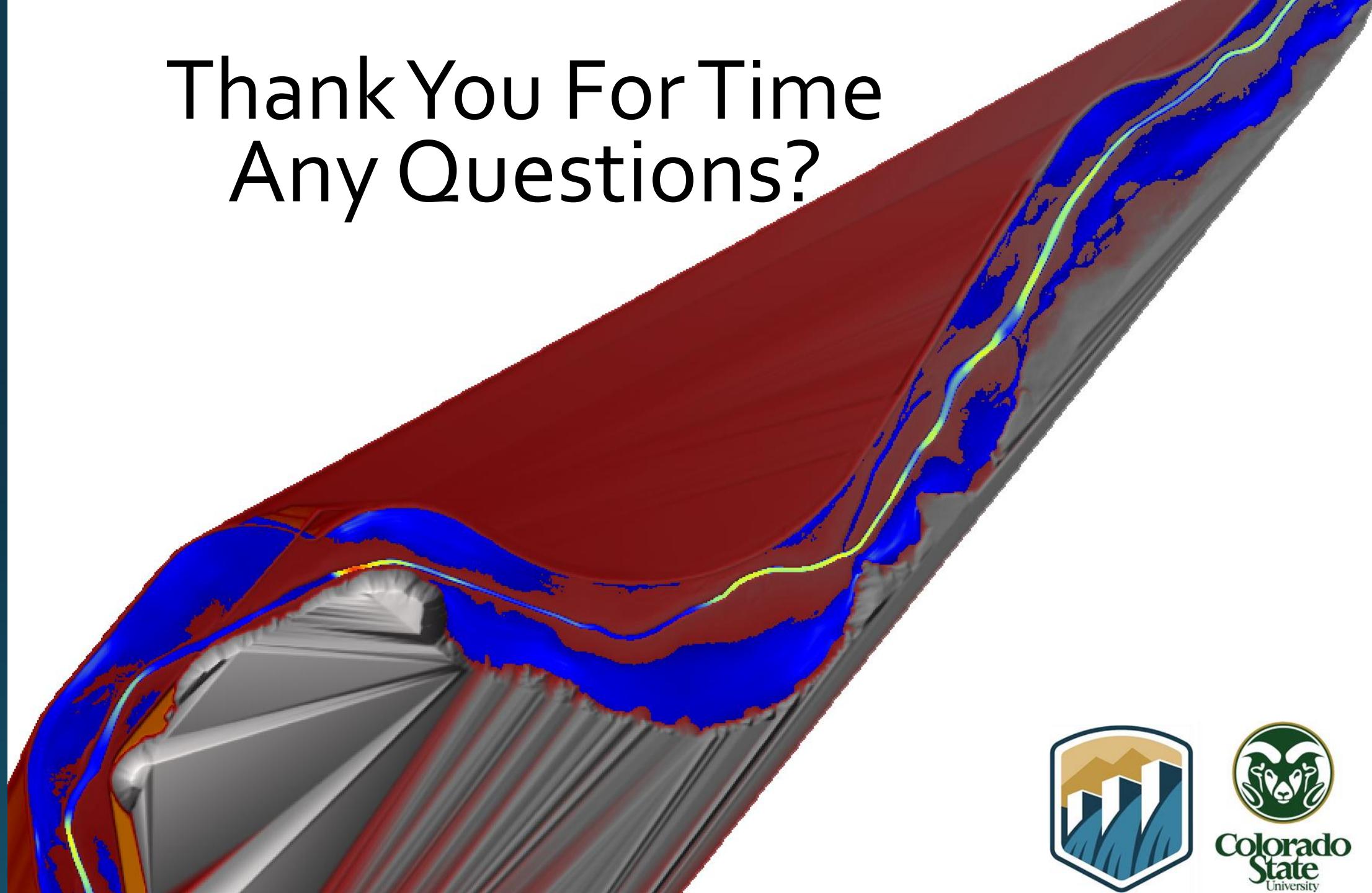
Subreach EB5



Summary

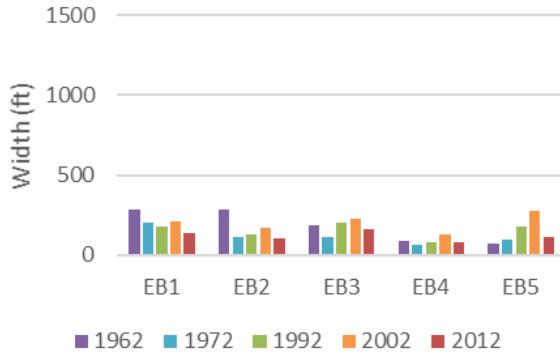
- Main inflow of water is during snowmelt, where main input of sediment is due to monsoons.
- Cycle of aggradation, degradation through the reach as a whole. Farther downstream these trends get more extreme potentially due to reservoir effects.
- History of aggradation and perching of the main channel.
- Currently there needs to be flows of around 4,750 cfs to have 25% levee overtopping.
- Perching has caused severe disconnection between floodplain and main channel.

Thank You For Time
Any Questions?

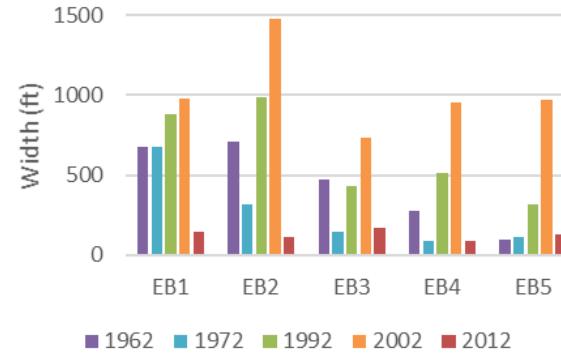


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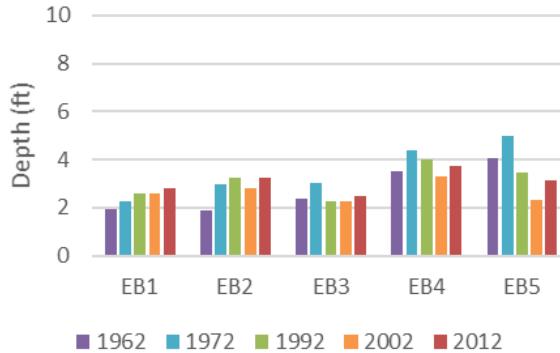
Top Width 1000 cfs



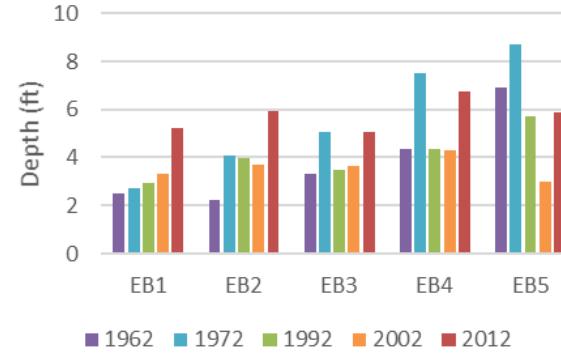
Top Width 3000 cfs



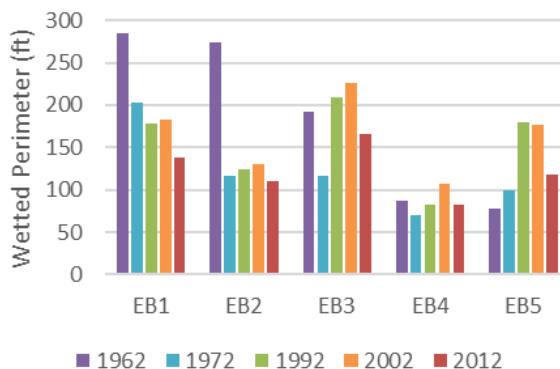
Hydraulic Depth 1000 cfs



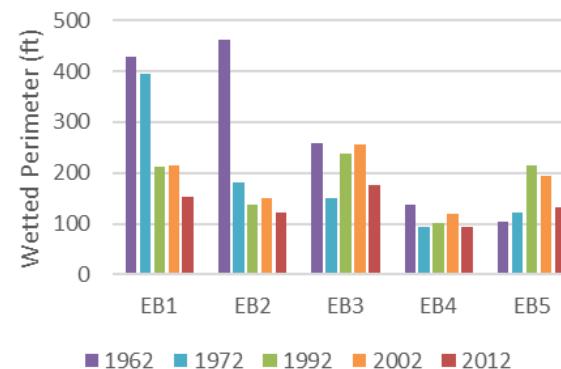
Hydraulic Depth 3000 cfs



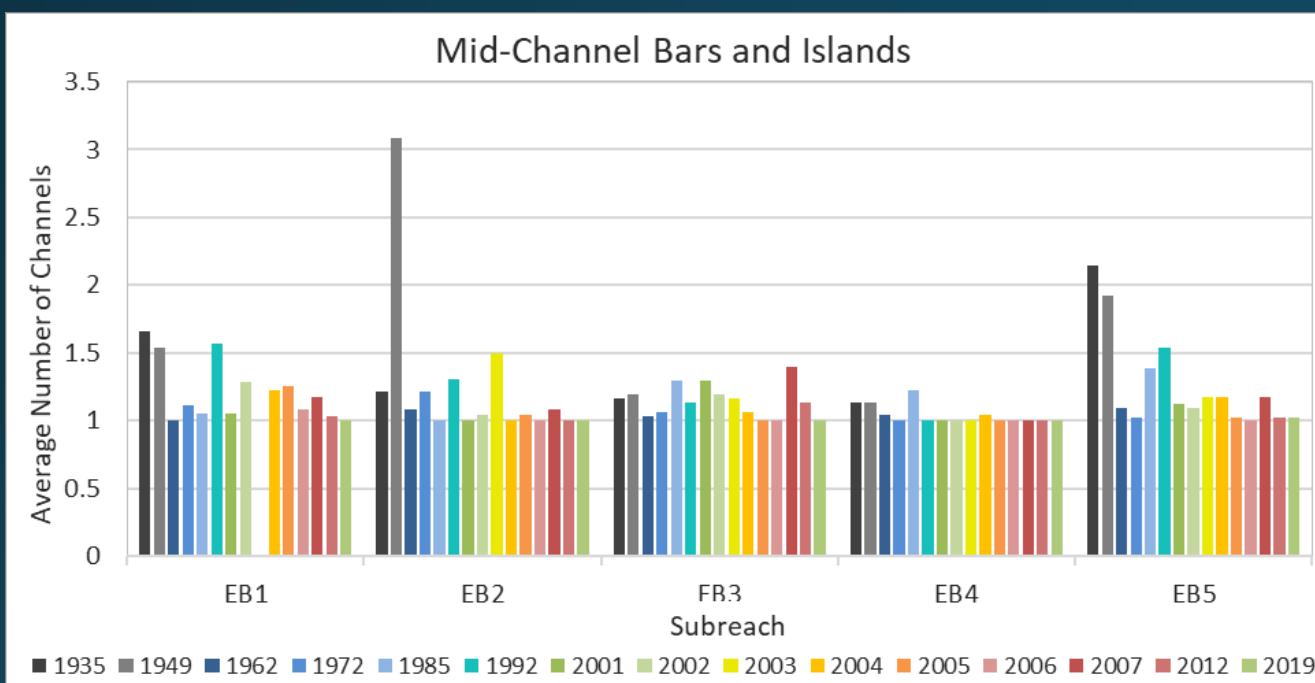
Wetted Perimeter 1000 cfs



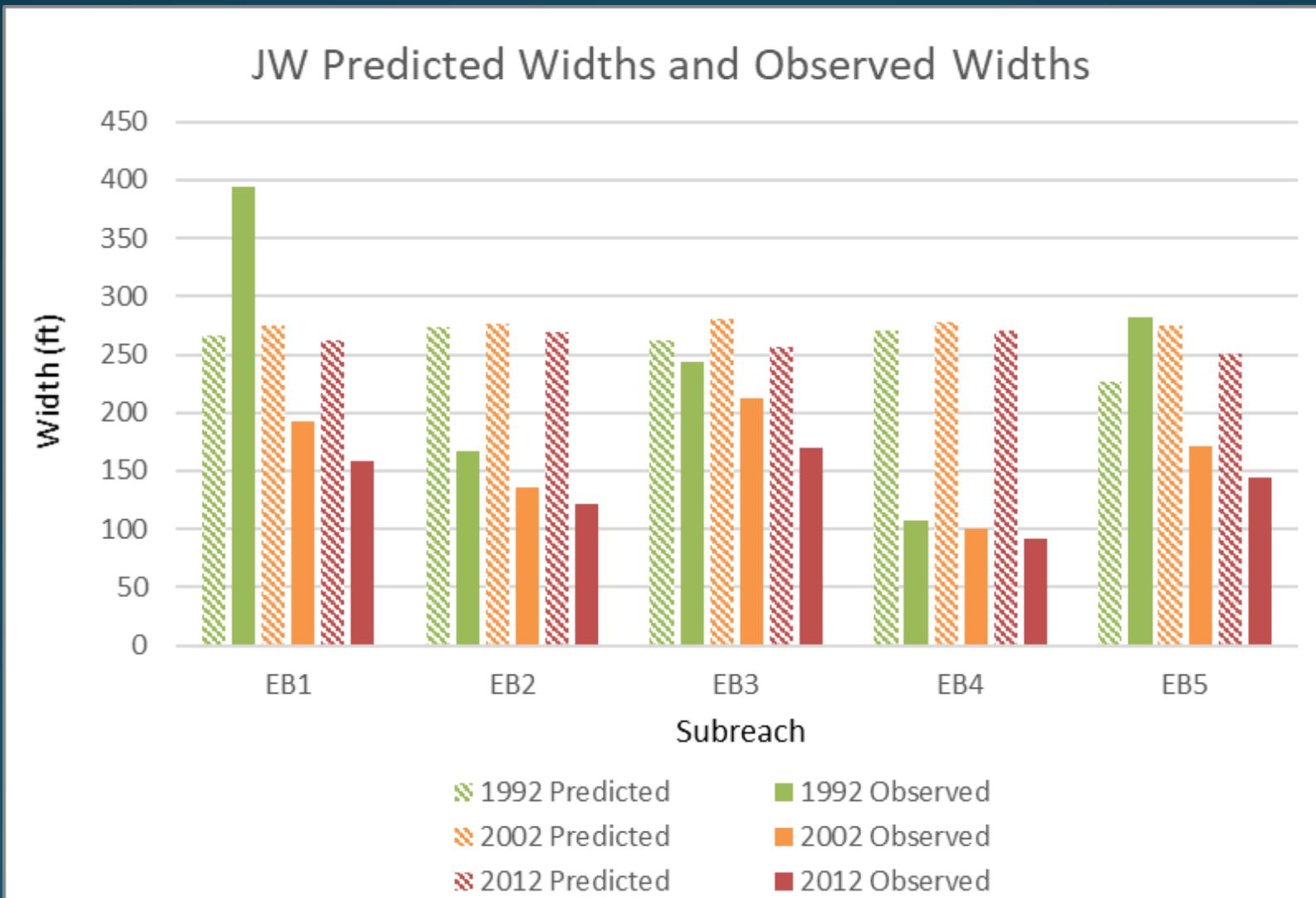
Wetted Perimeter 3000 cfs



Midchannel Bars (2002 and 2012 Example)

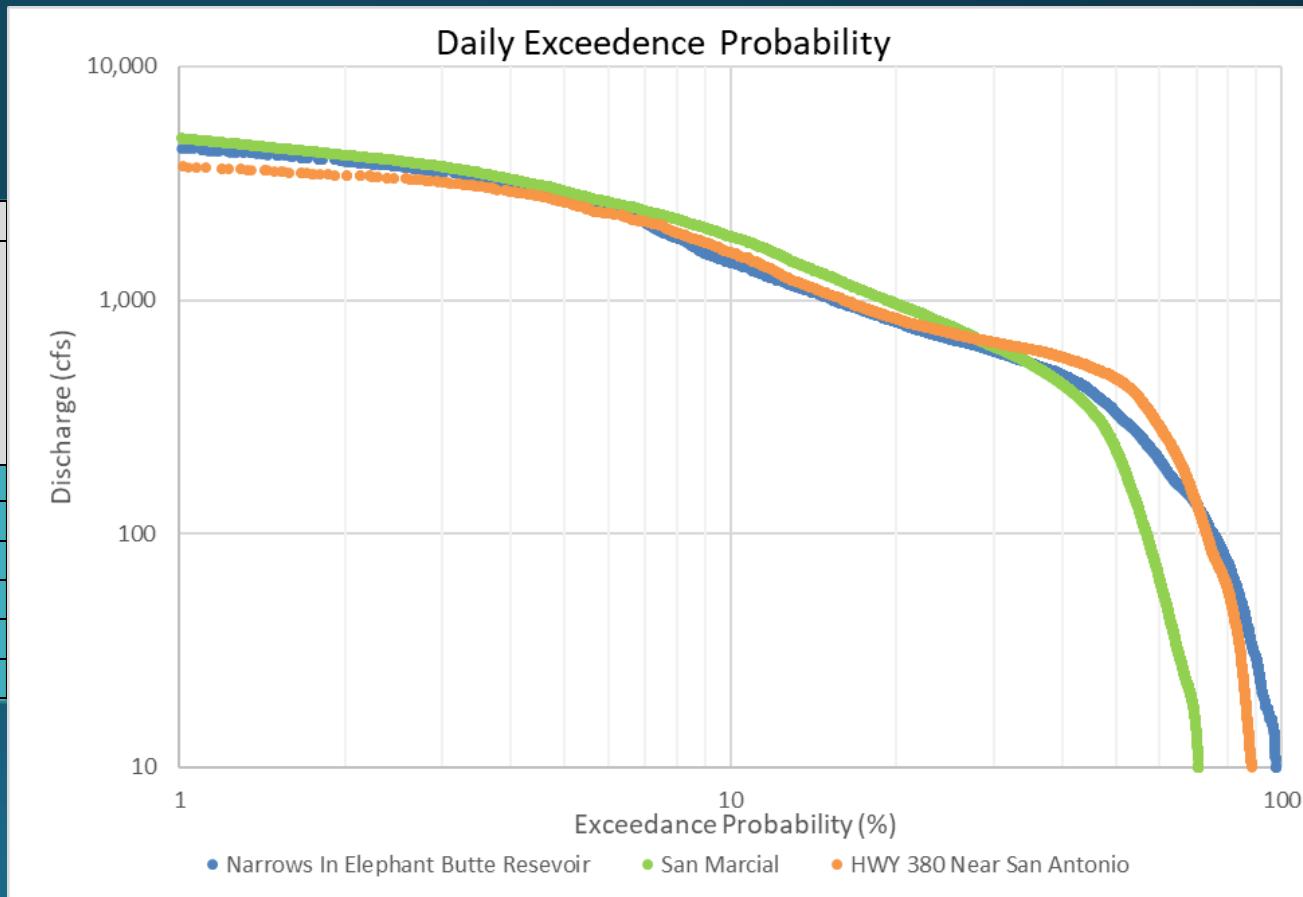


JW Calculations

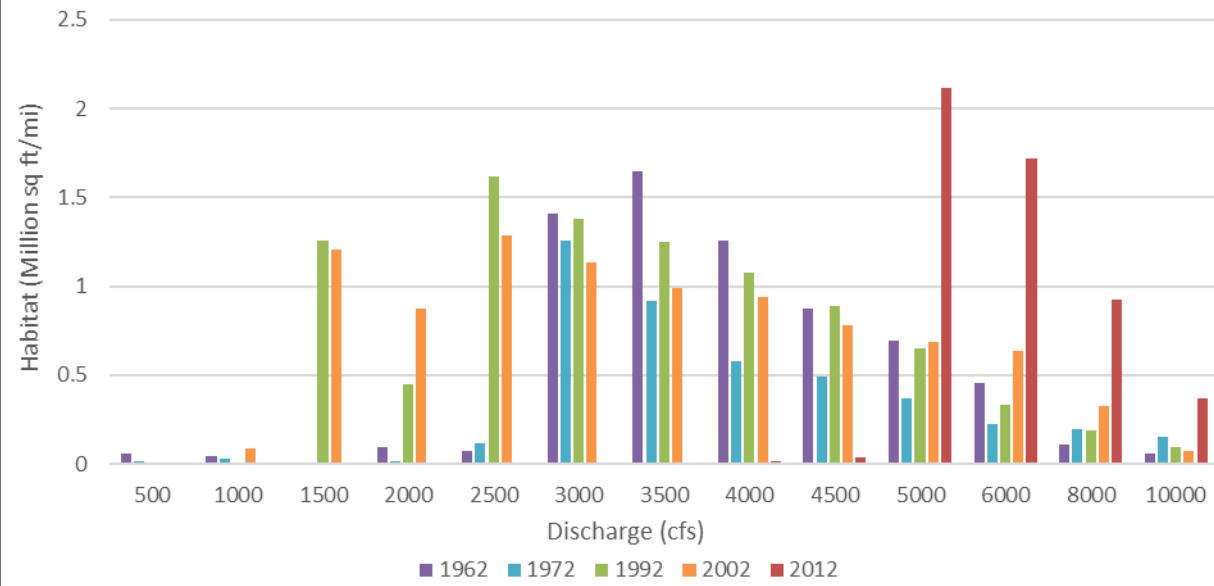


Flow Exceedance

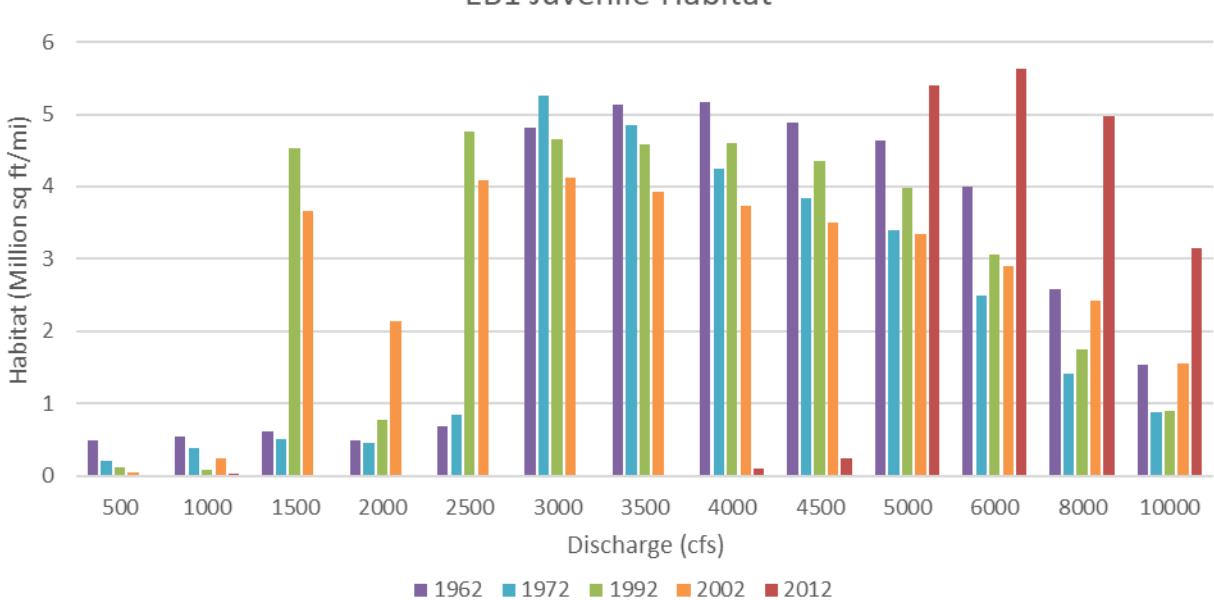
Probability of Exceedance	Discharge (cfs)		
	08358400 Rio Grande Floodway at San Marcial, NM (October 1, 1949 – May 25, 2021)	08359500 Rio Grande at Narrows in Elephant Butte Reservoir, NM (April 1, 1951 – May 25, 2021)	08355490 Rio Grande Above US HWY 380 NR San Antonio, NM (September 30, 2005 – May 25, 2021)
1%	4926	4483	3739
10%	1870	1449	1602
25%	775	681	723
50%	232	330	461
75%	0.009	100	82
90%	0.004	29	4



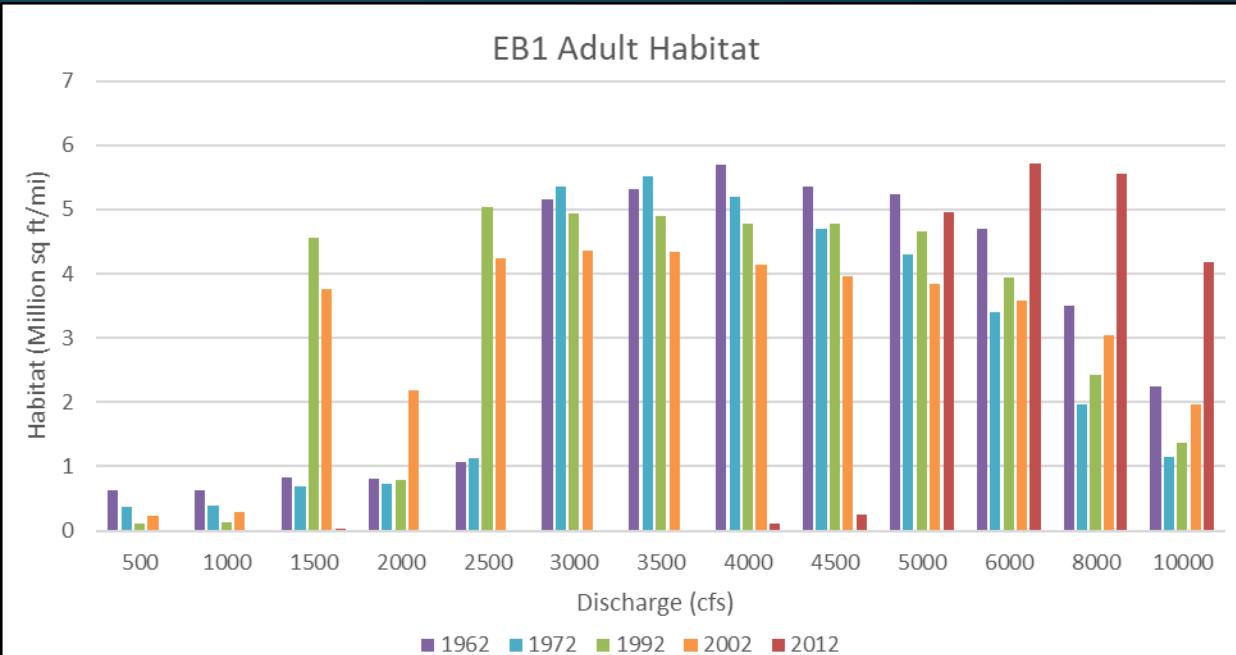
EB1 Larvae Habitat



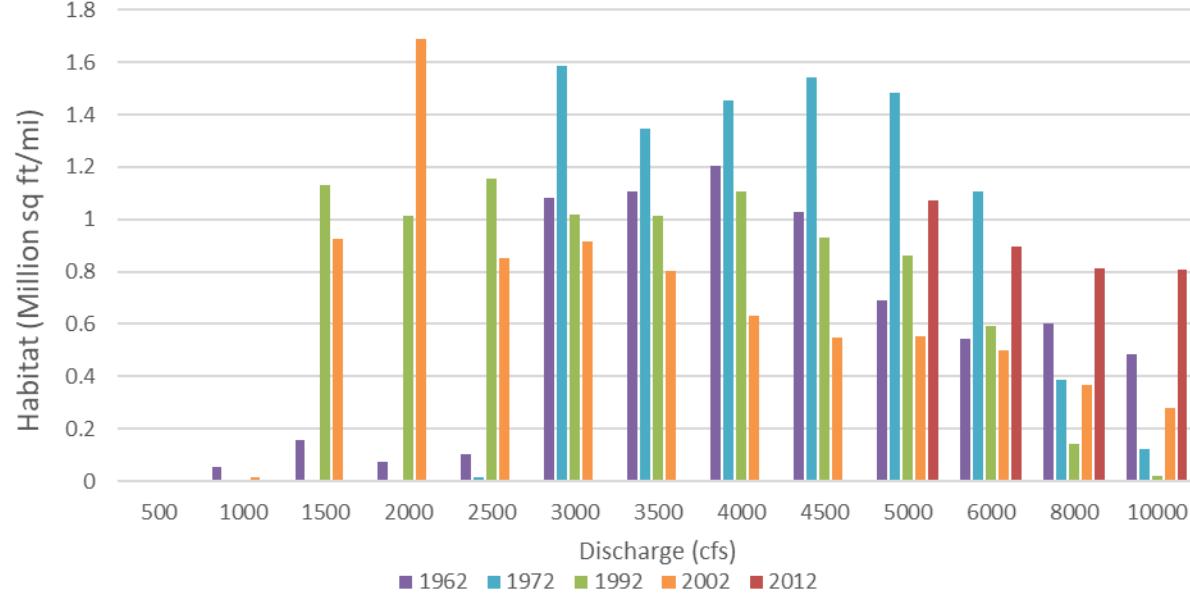
EB1 Juvenile Habitat



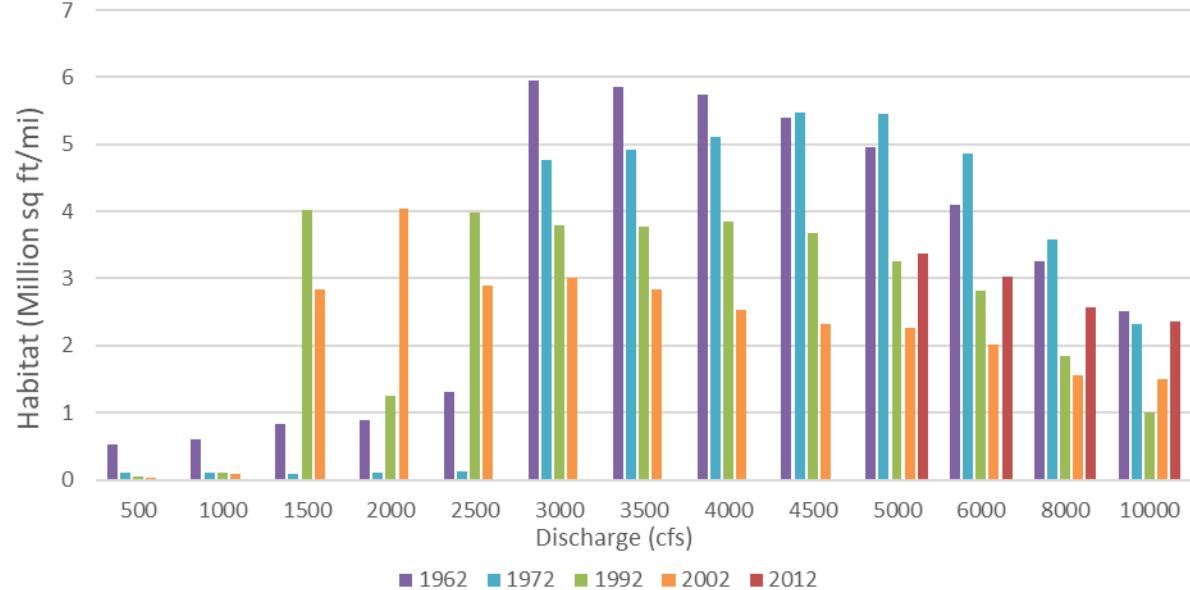
EB1 Adult Habitat



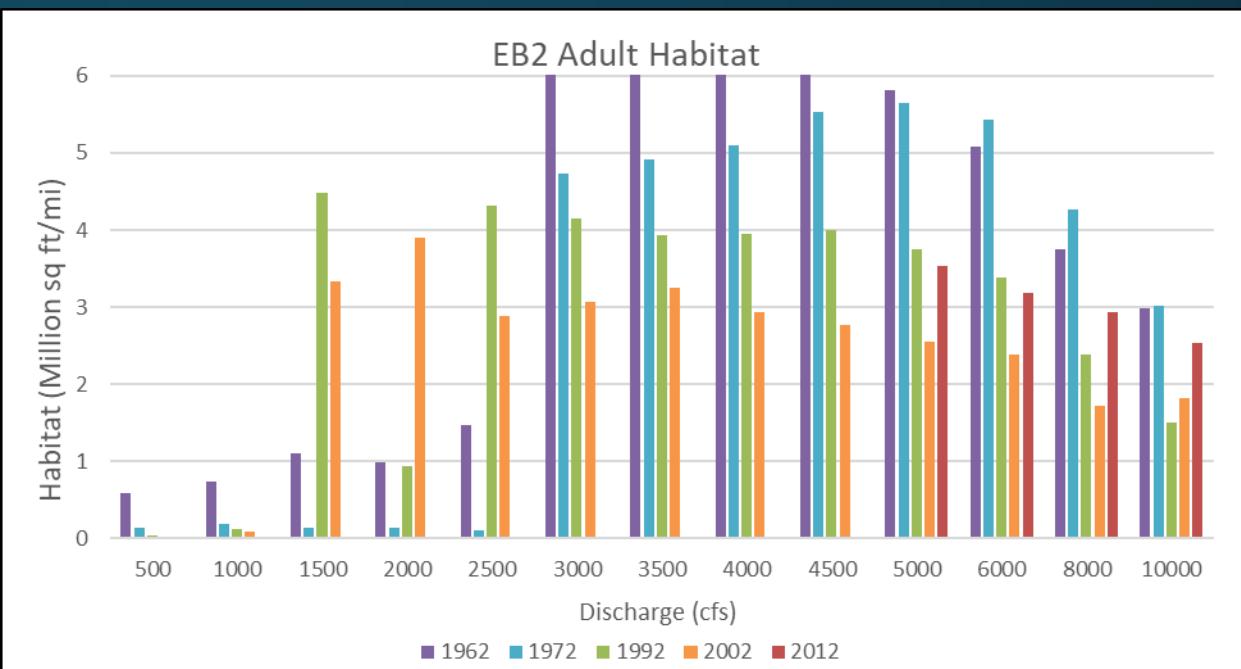
EB2 Larvae Habitat



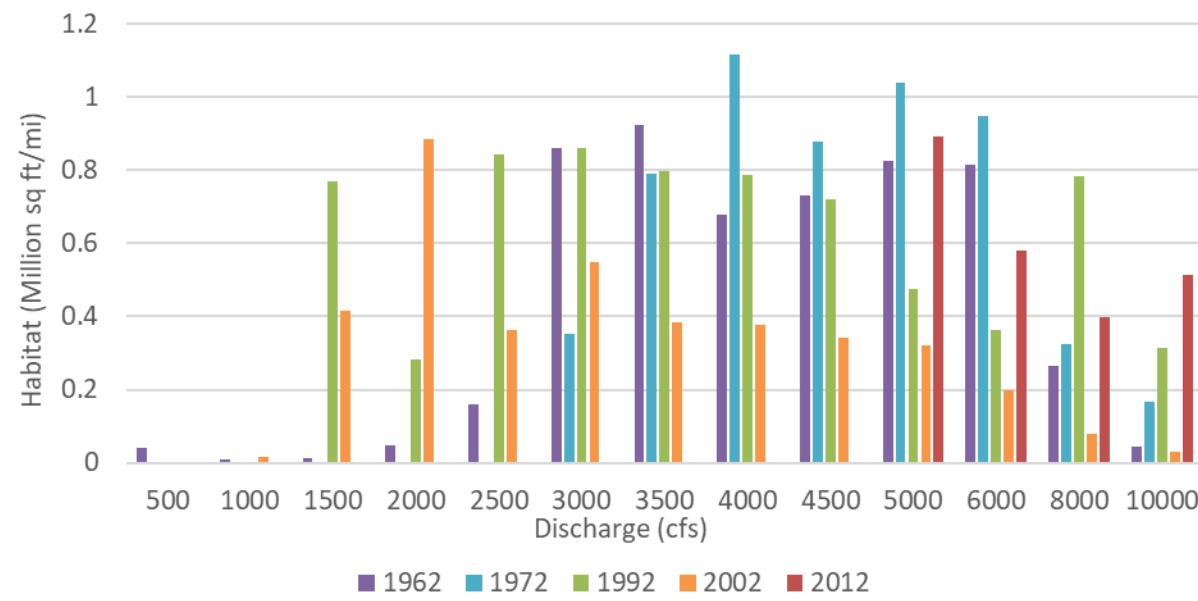
EB2 Juvenile Habitat



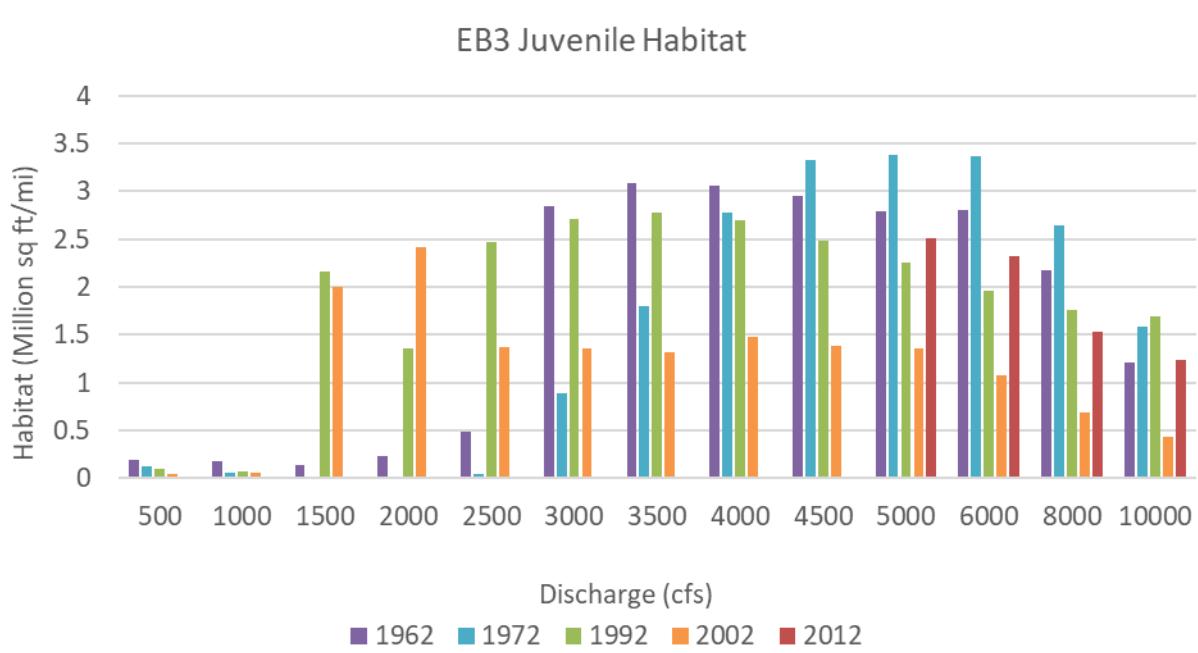
EB2 Adult Habitat



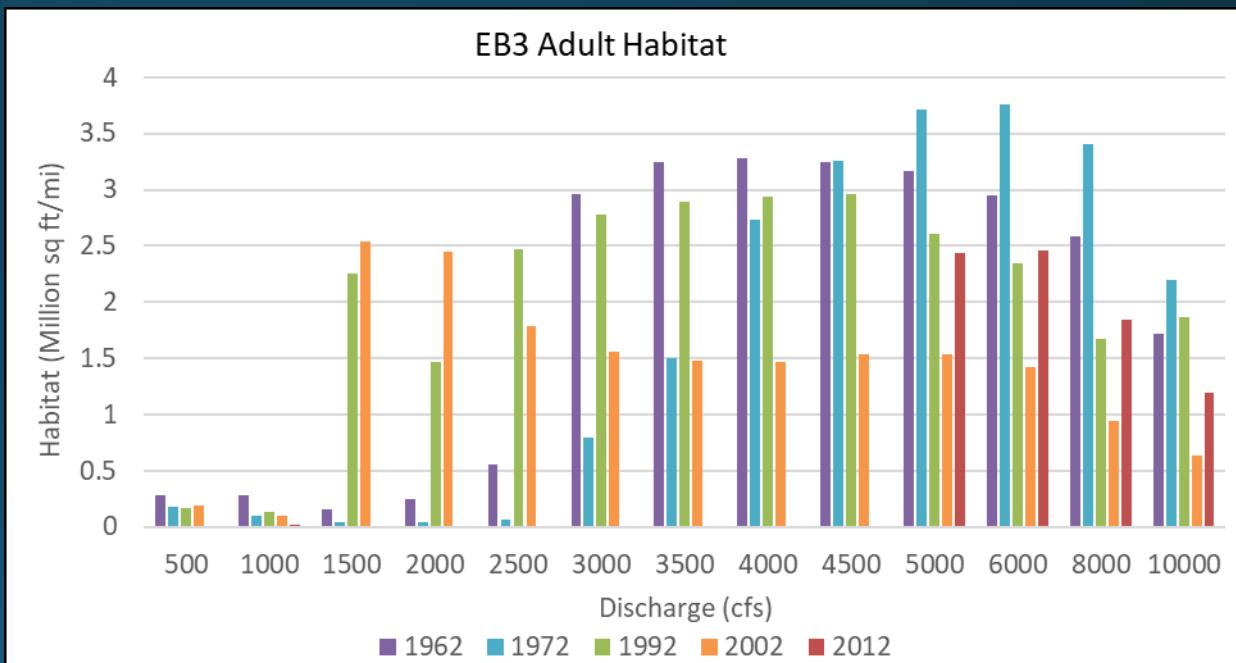
EB3 Larvae Habitat



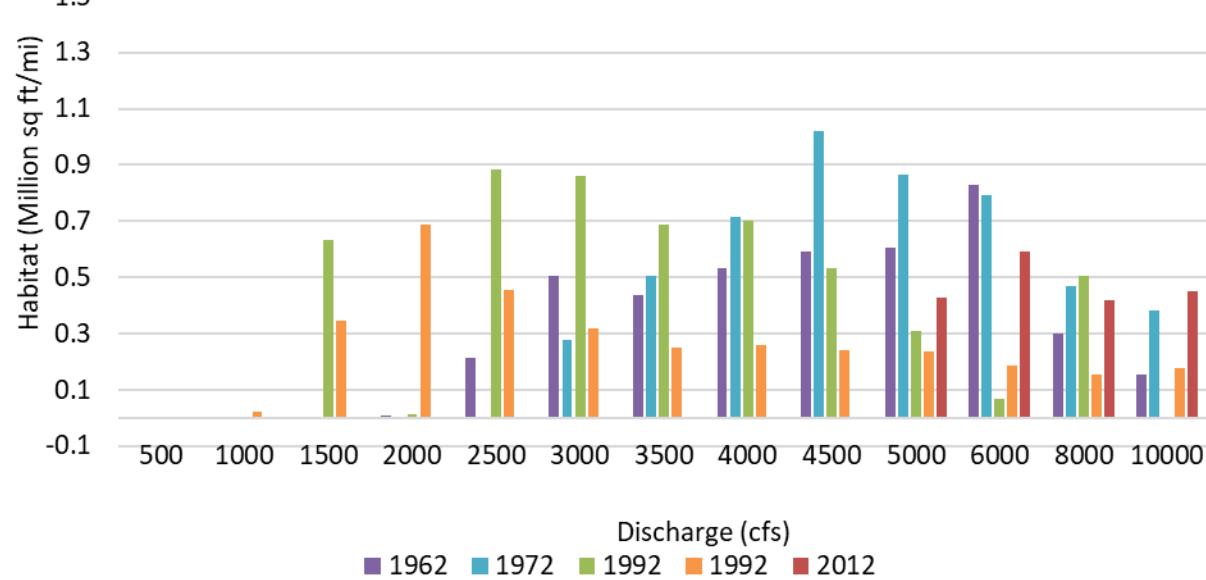
EB3 Juvenile Habitat



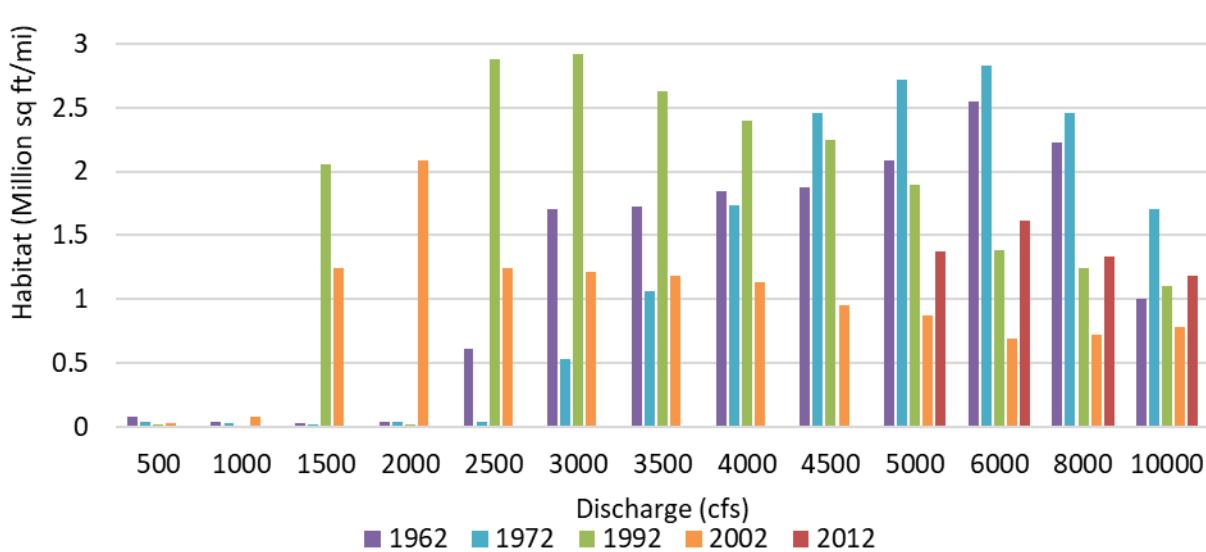
EB3 Adult Habitat



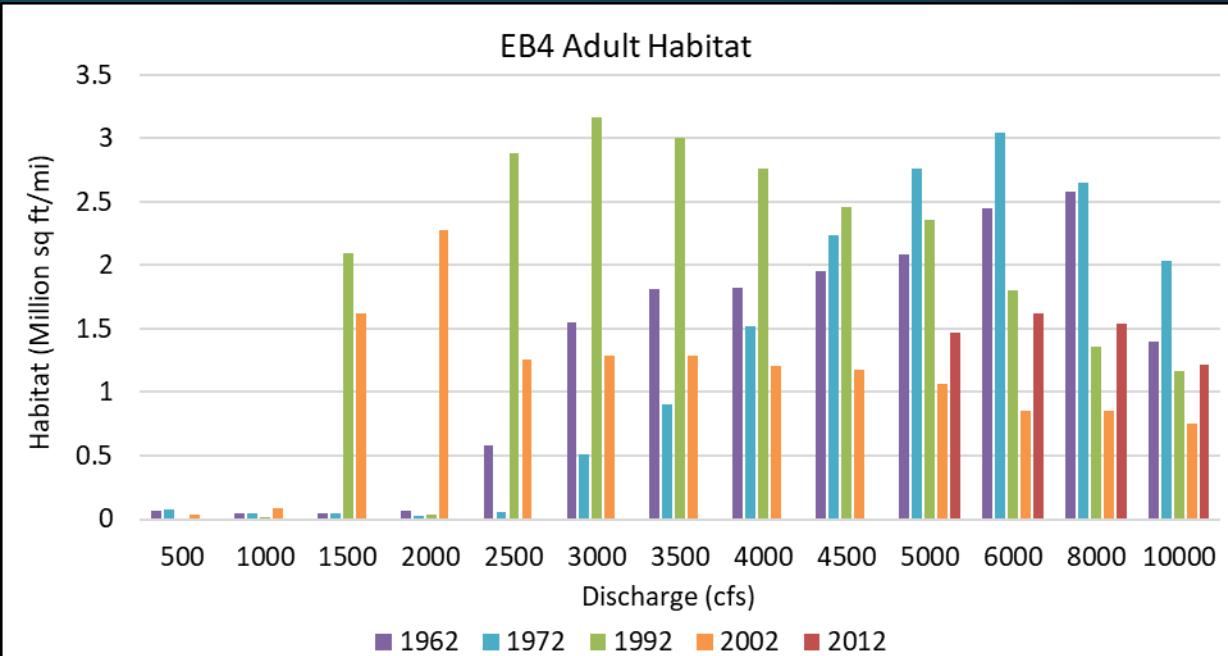
EB4 Larvae Habitat

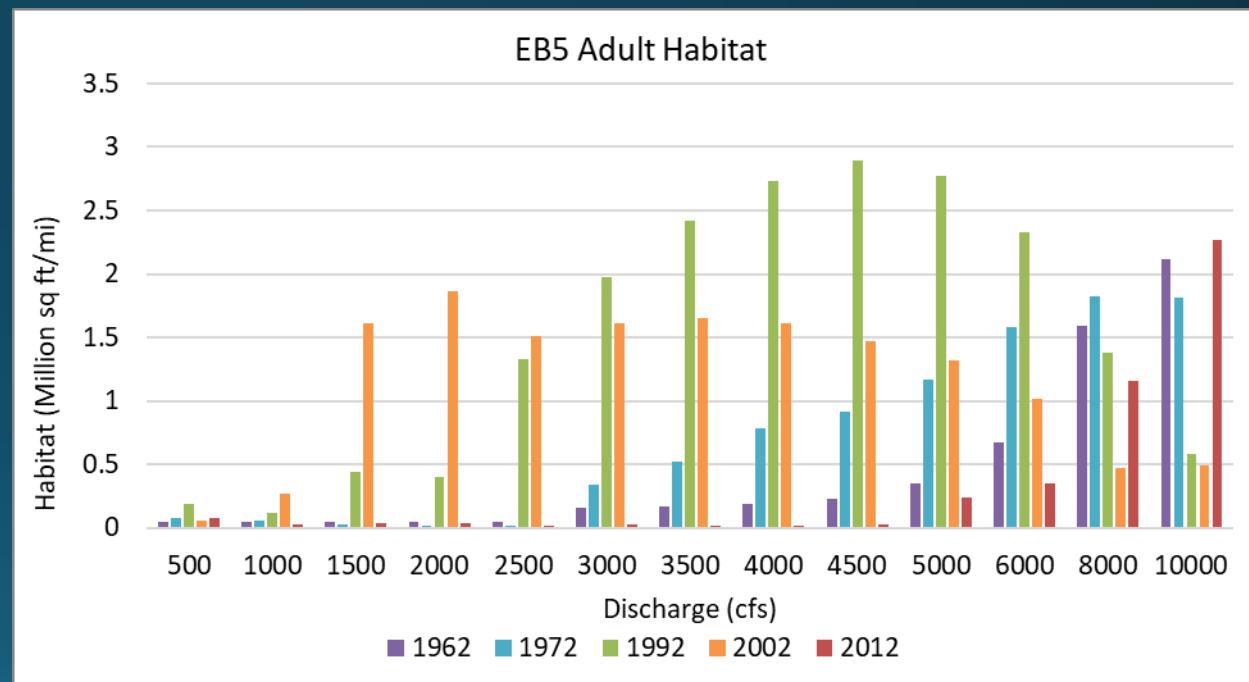
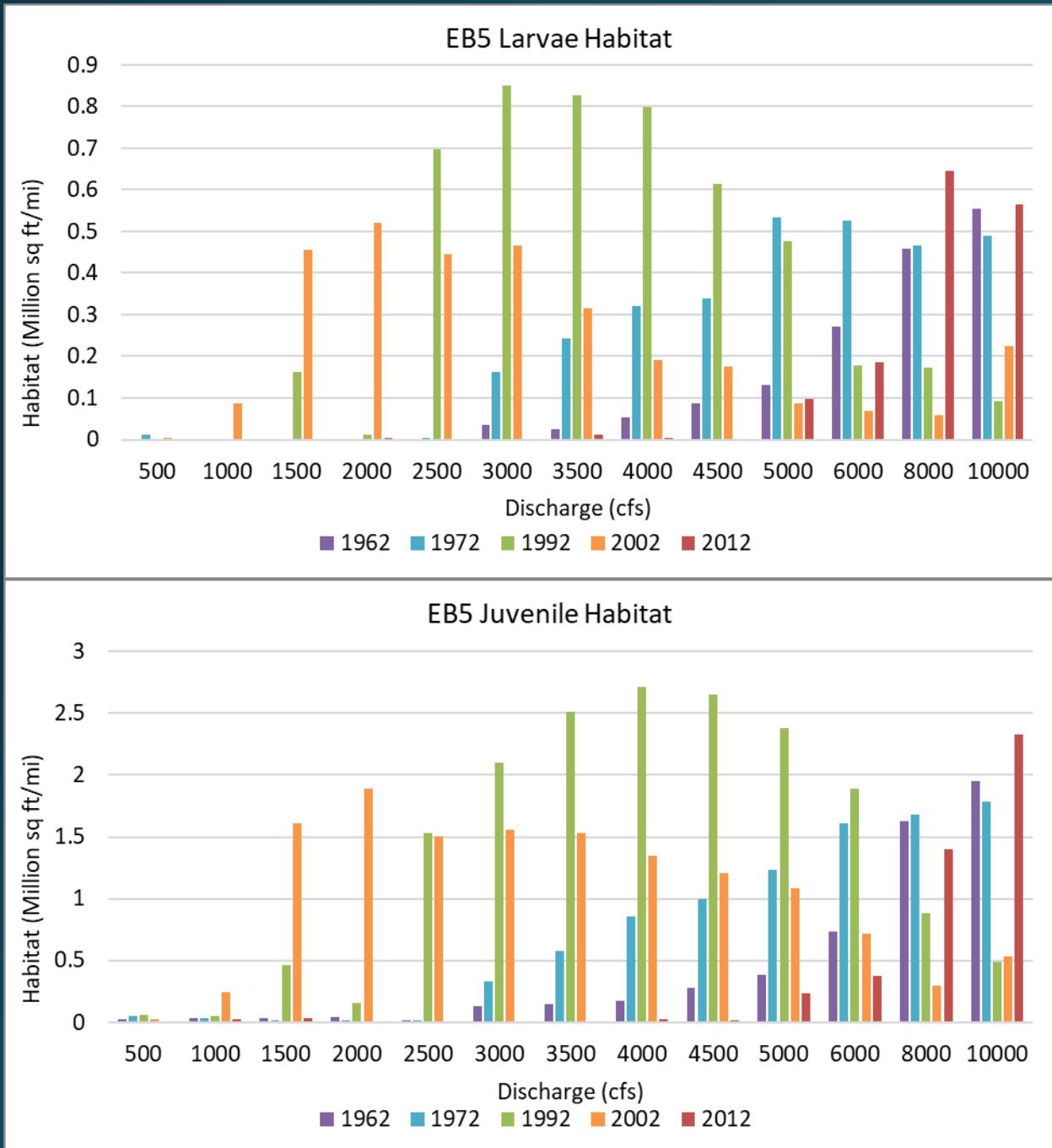


EB4 Juvenile Habitat

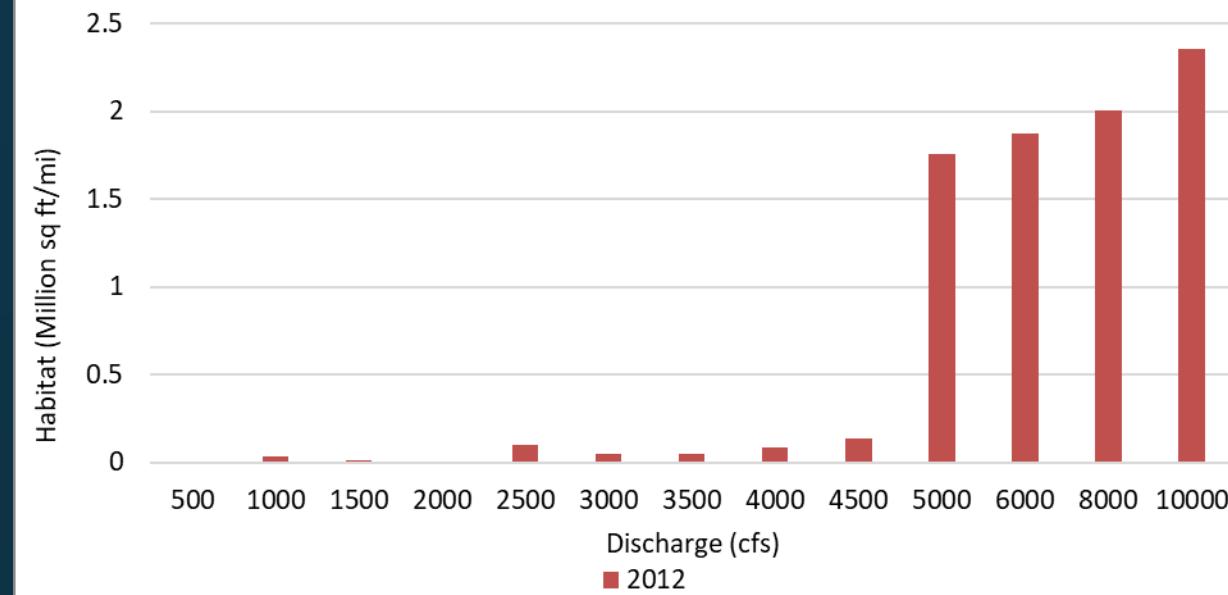


EB4 Adult Habitat

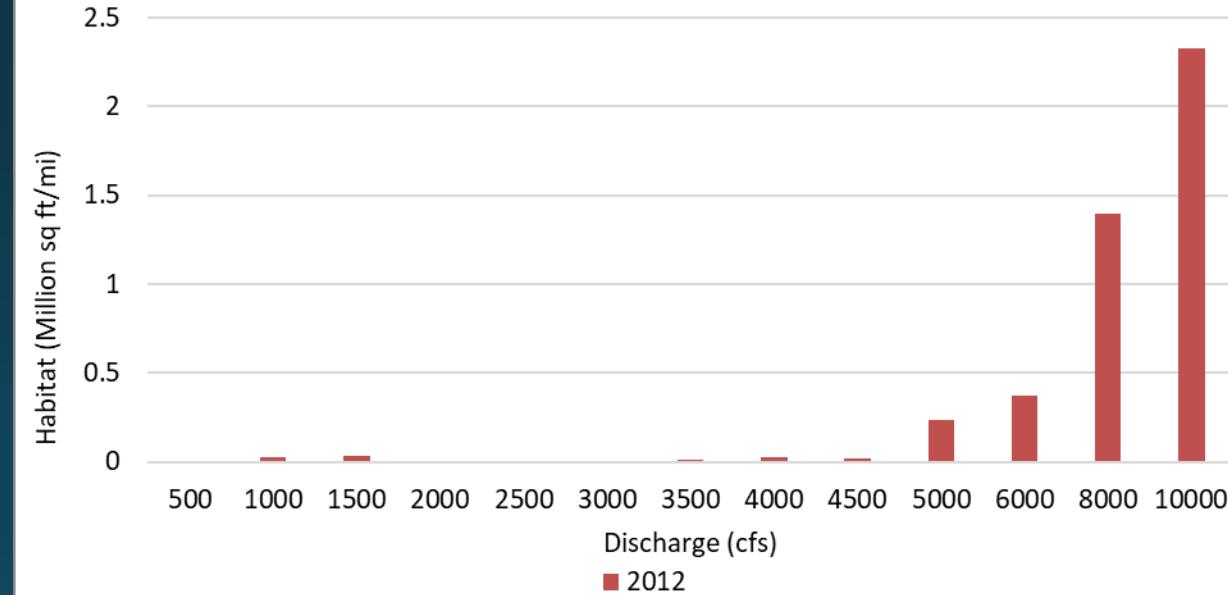




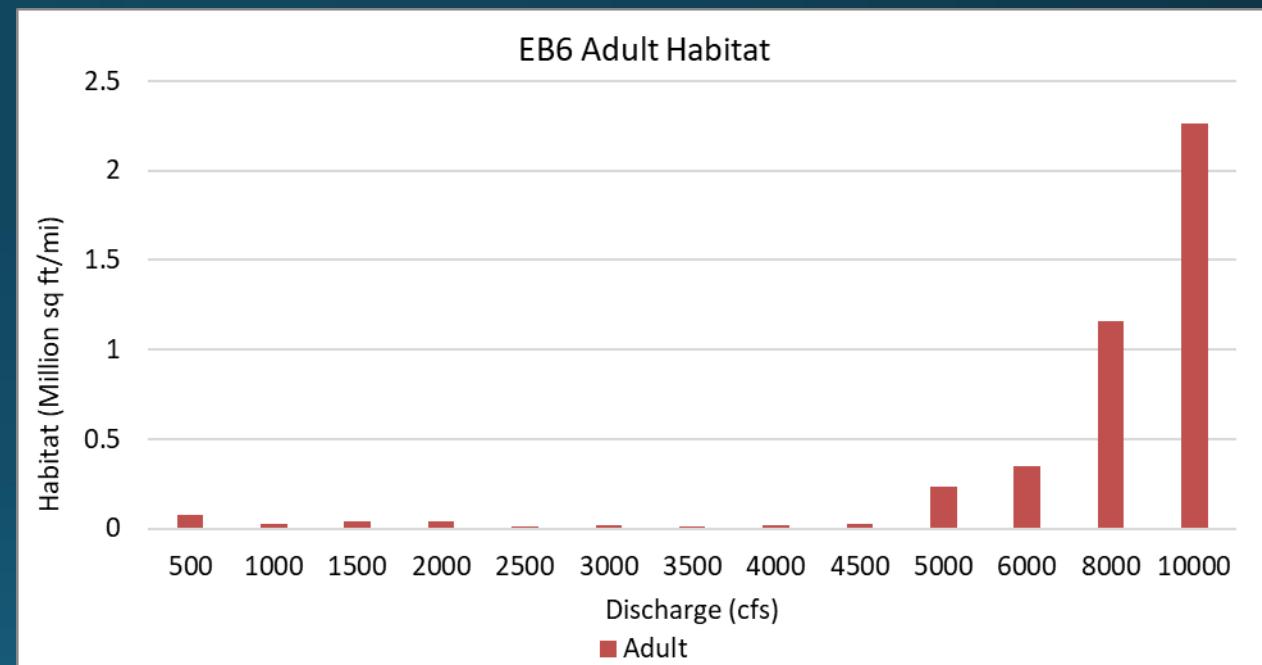
EB6 Larvae Habitat



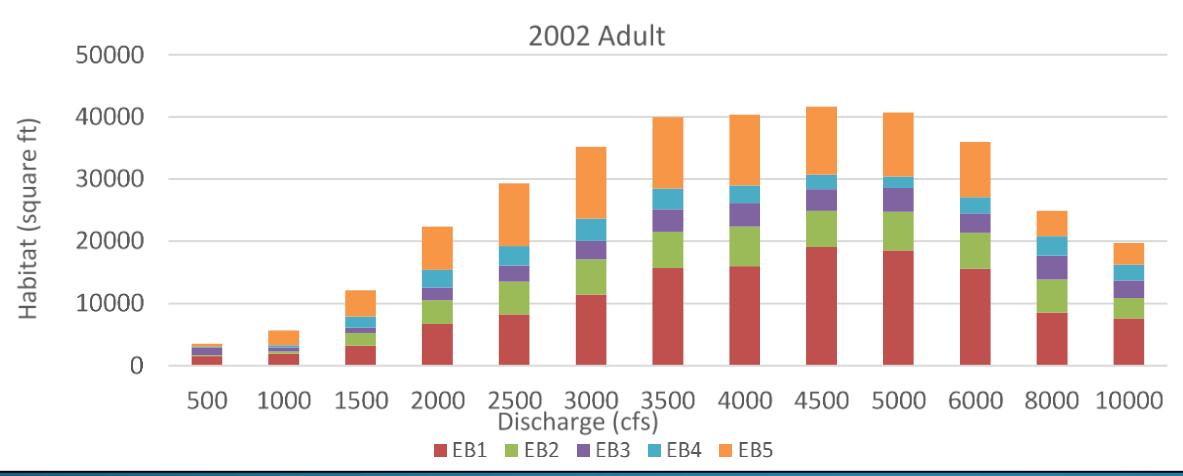
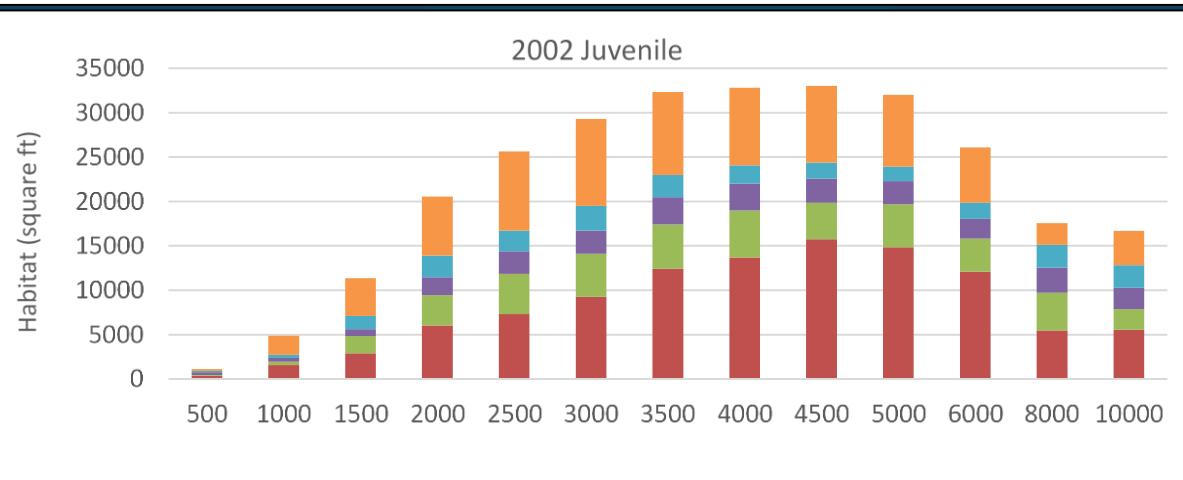
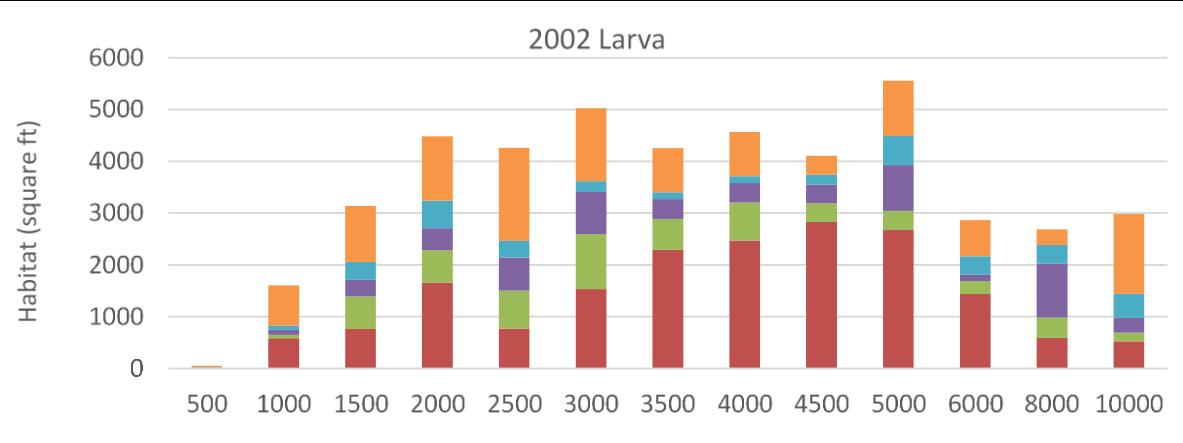
EB6 Juvenile Habitat

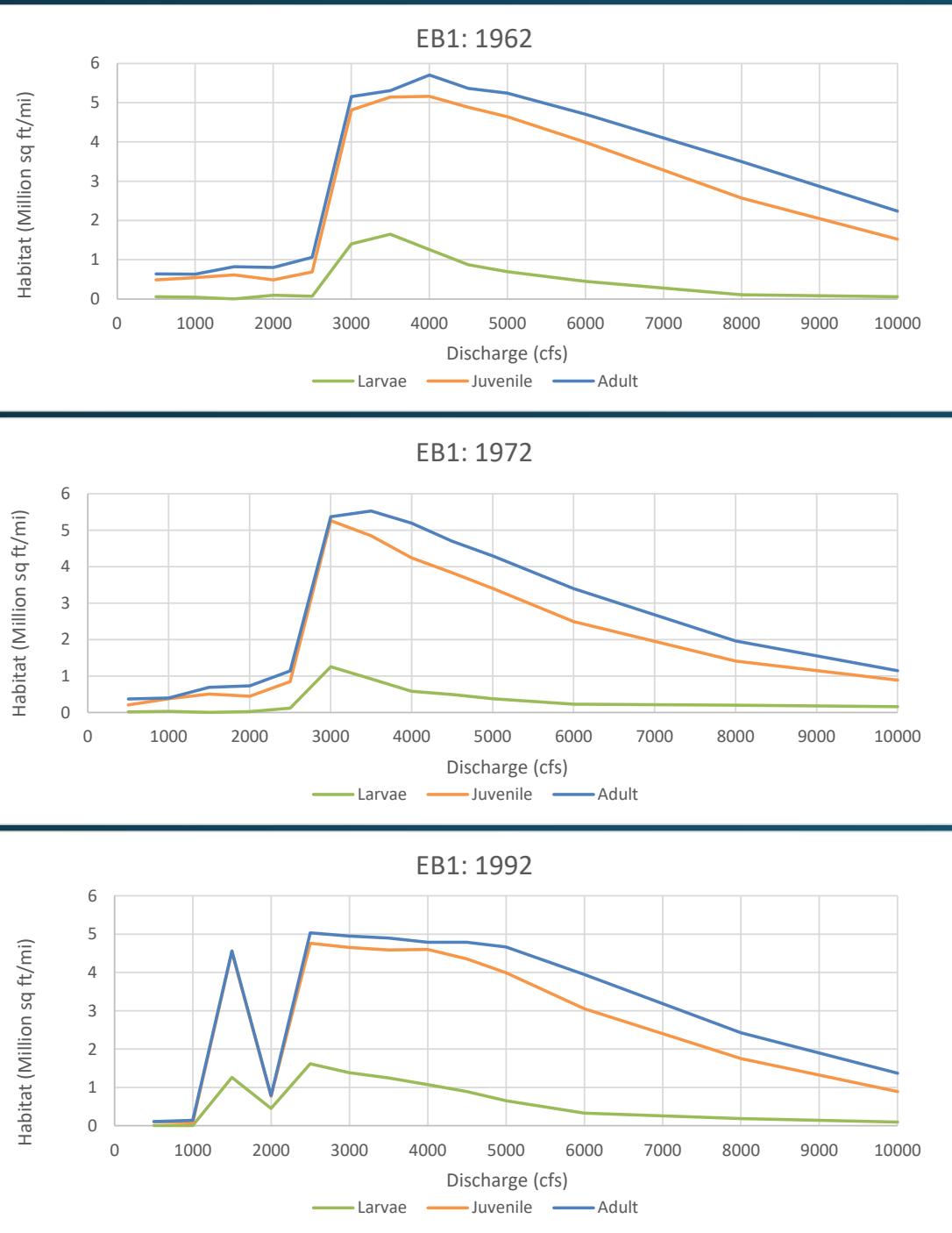


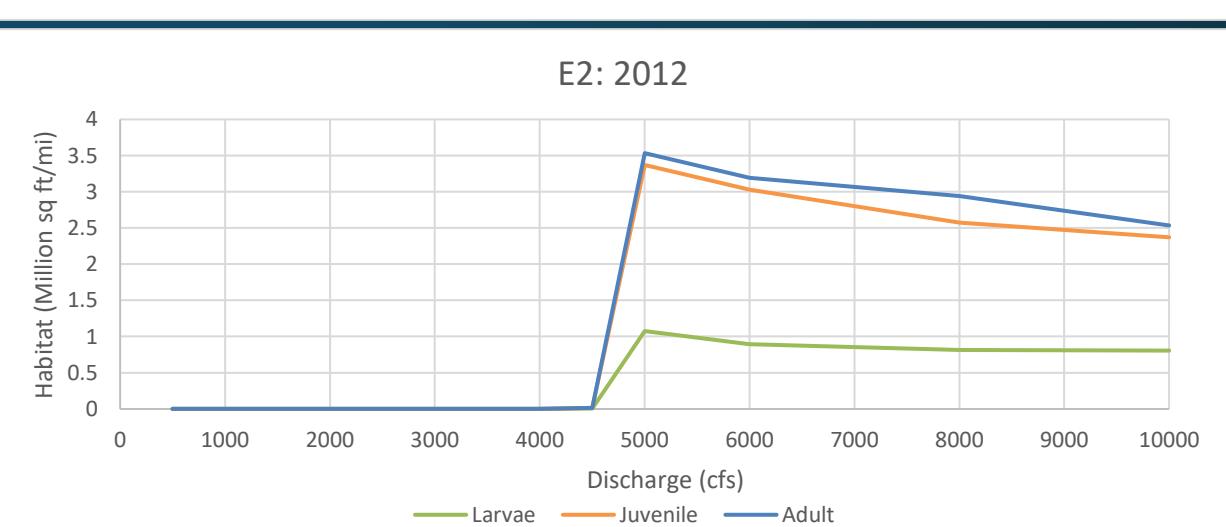
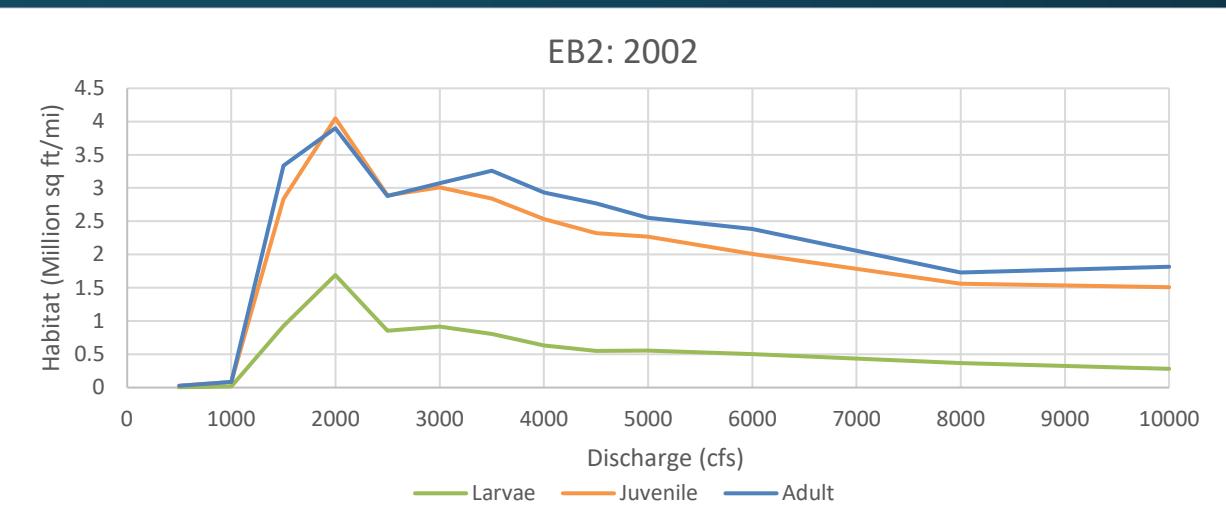
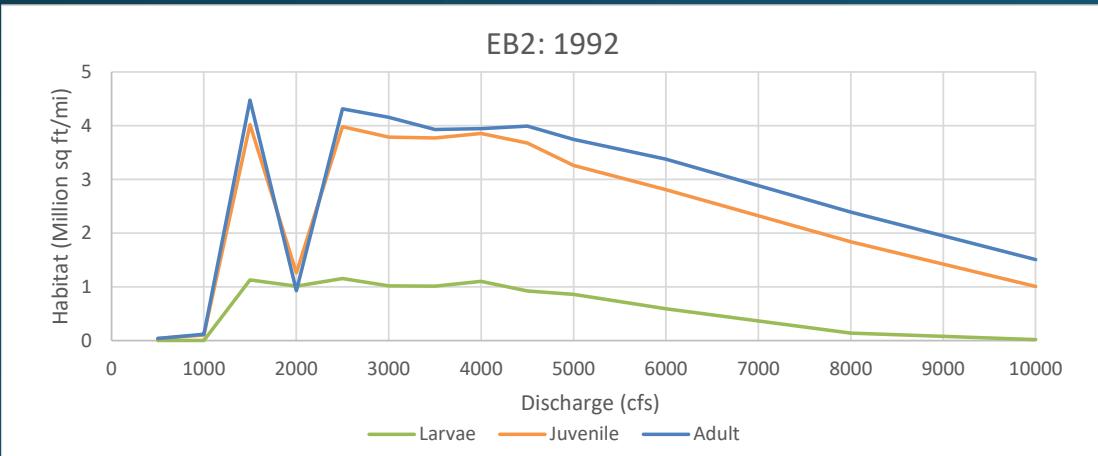
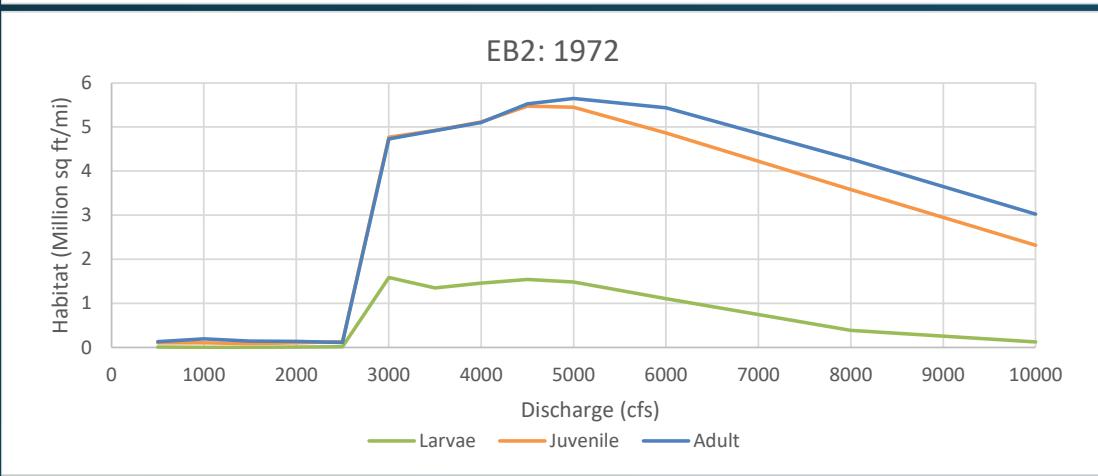
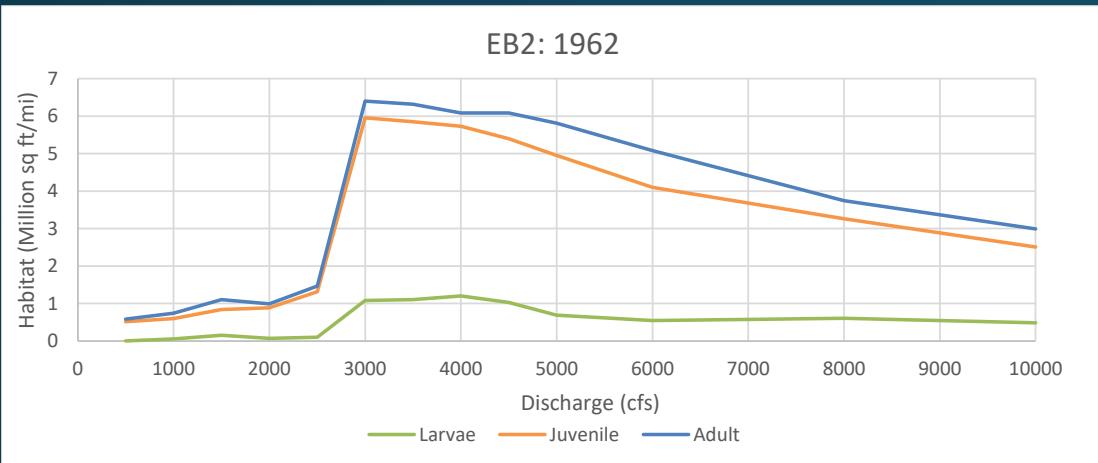
EB6 Adult Habitat



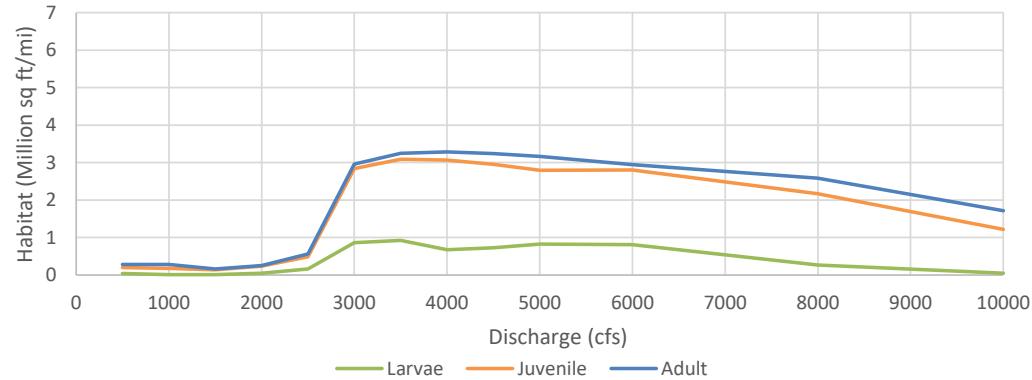




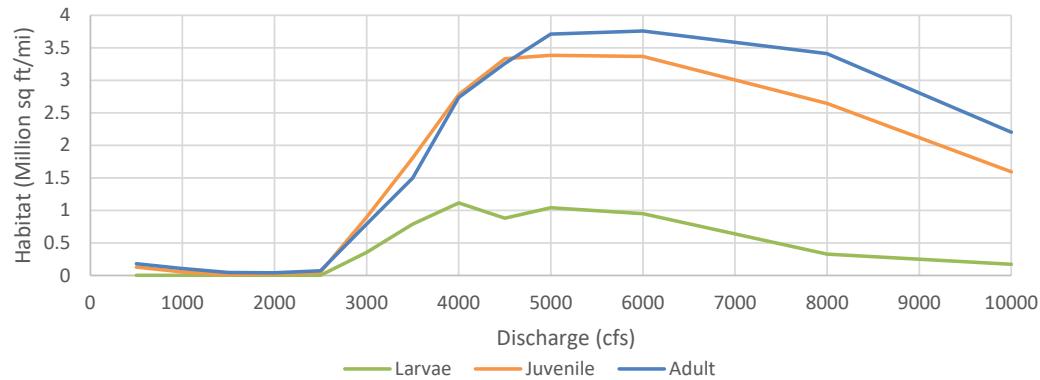




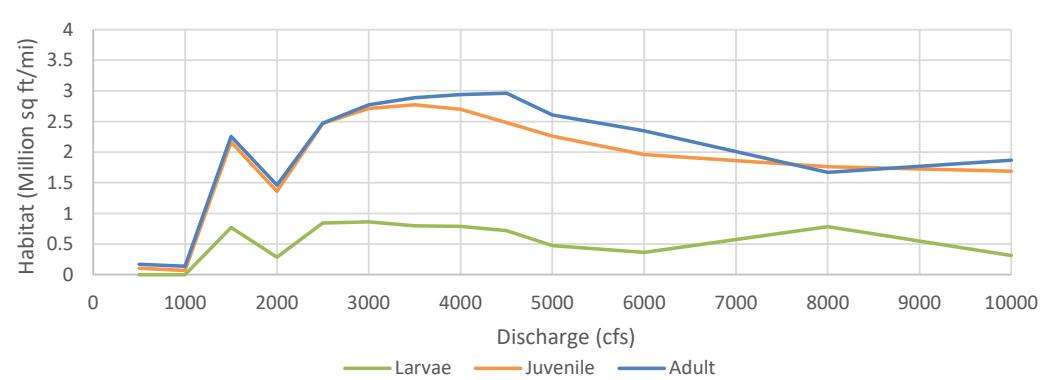
EB3: 1962



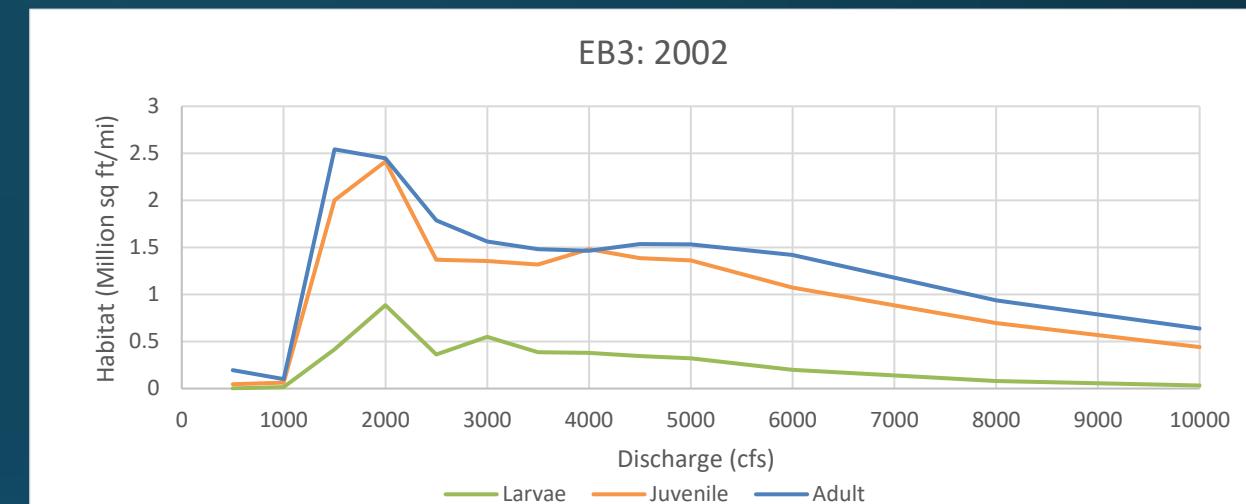
EB3: 1972



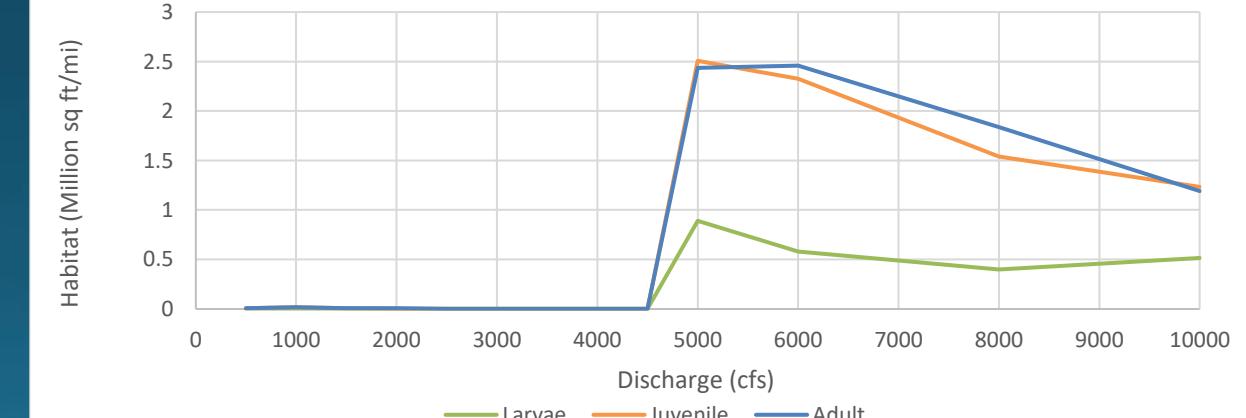
EB3: 1992

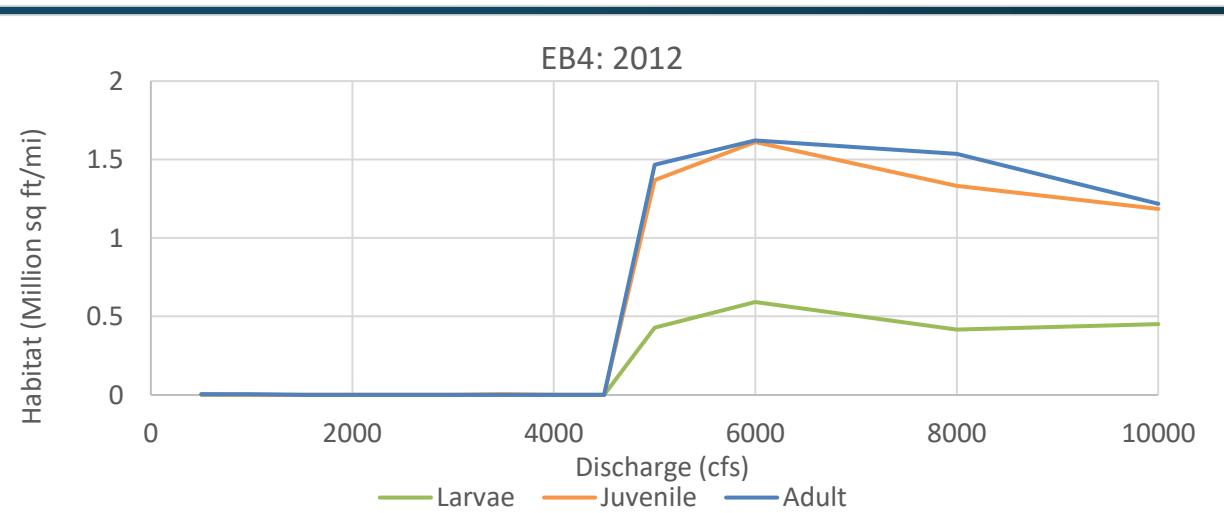
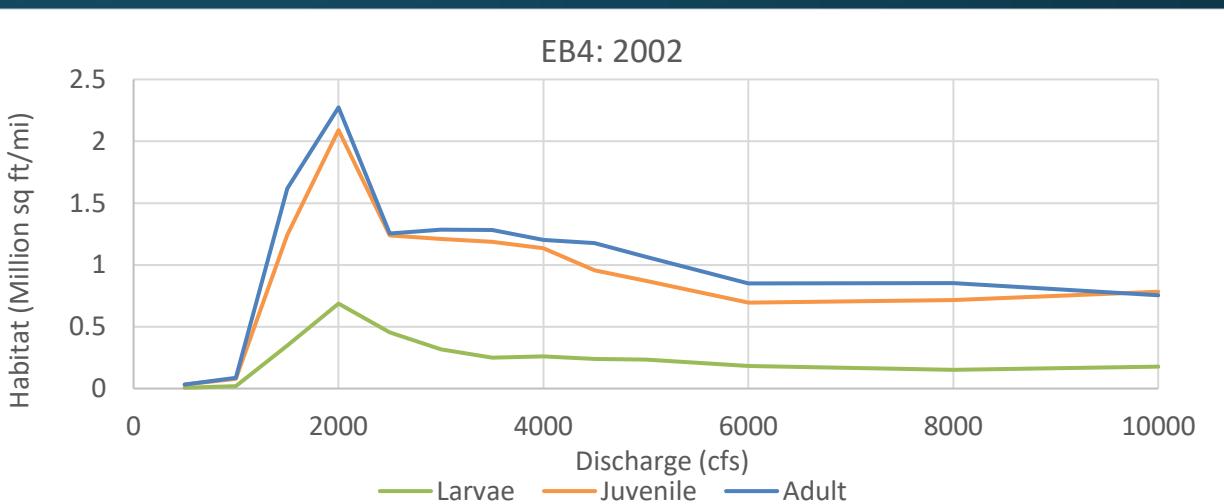
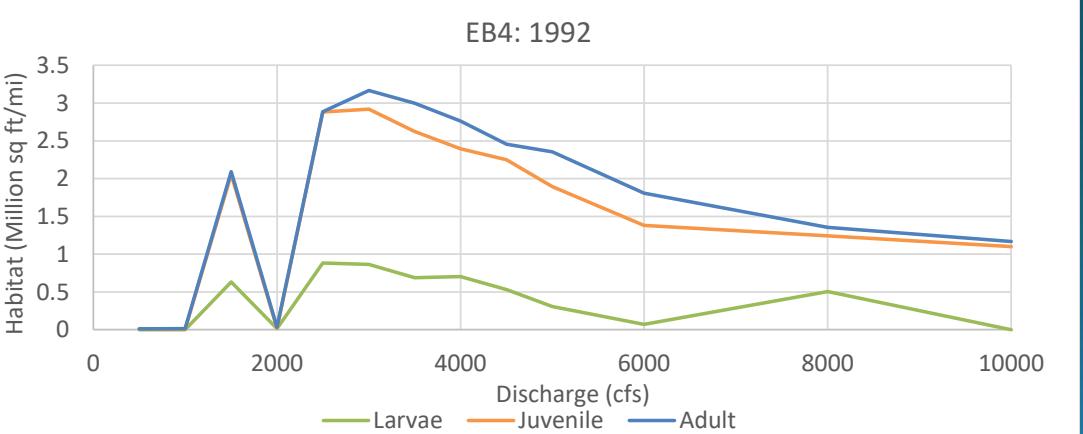
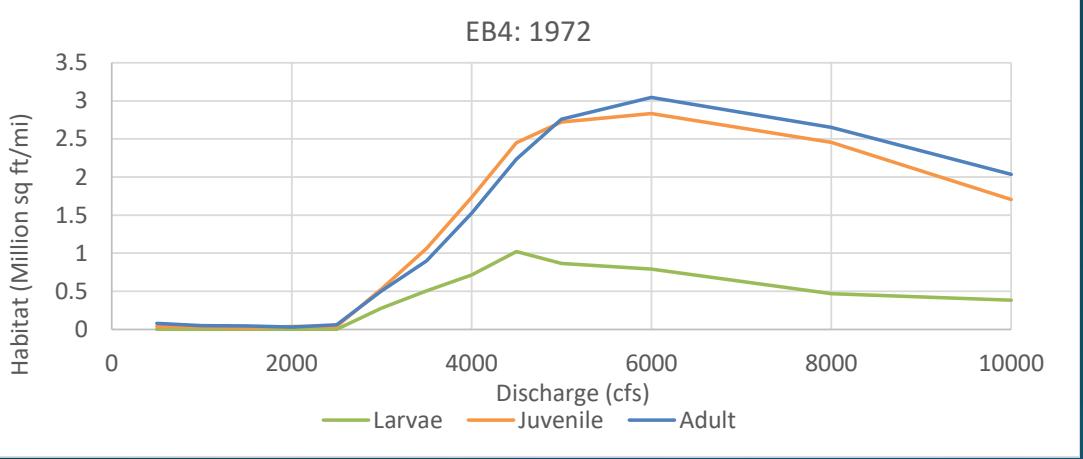
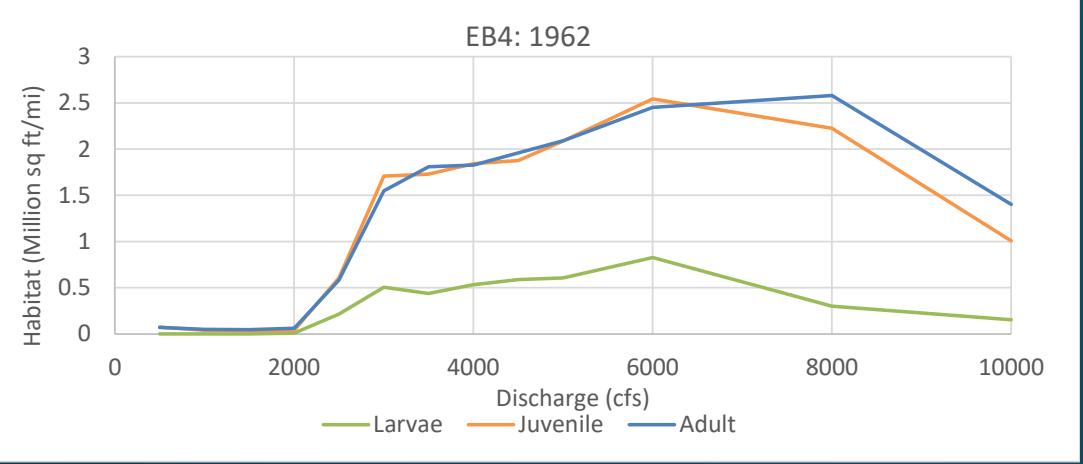


EB3: 2002

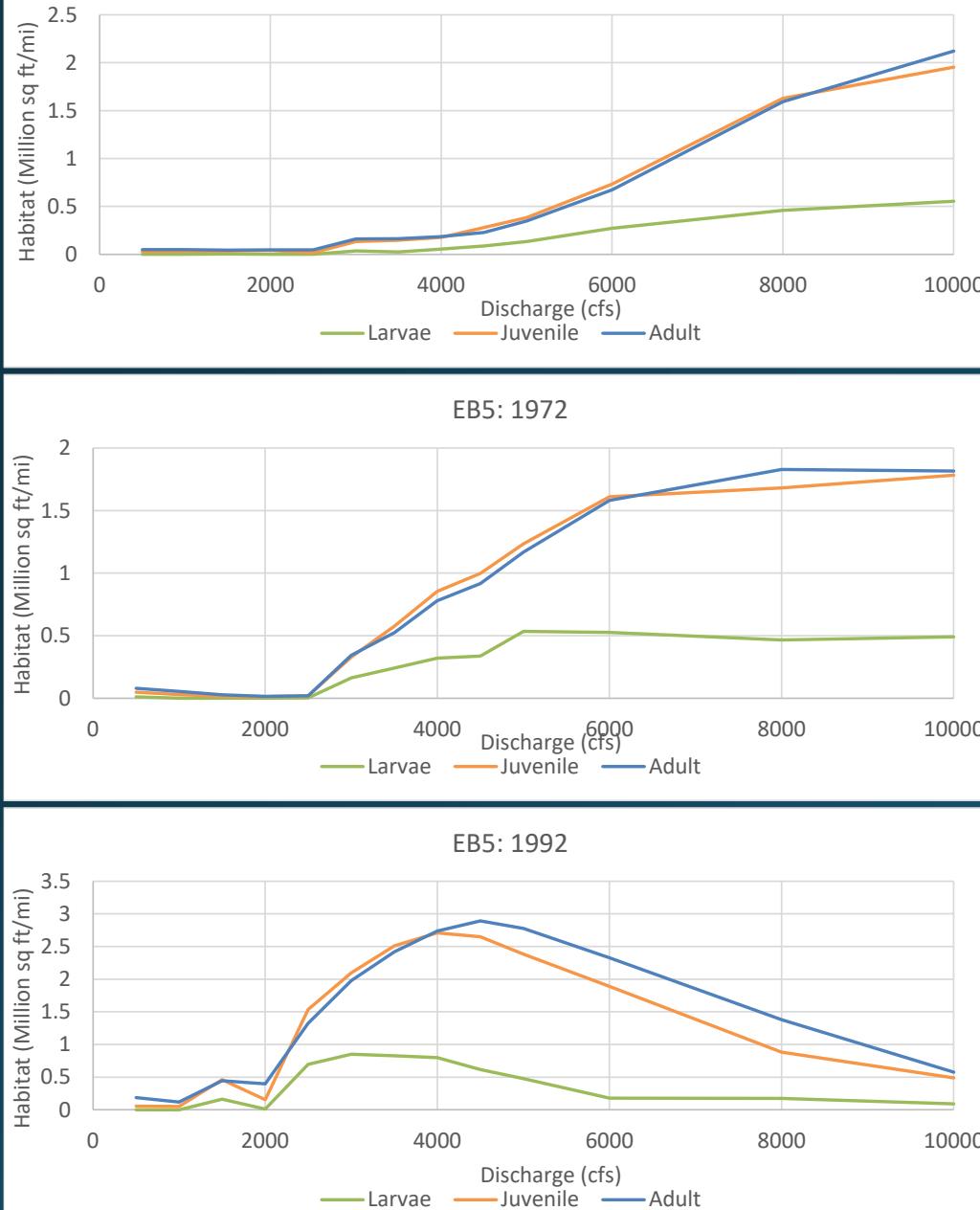


EB3: 2012

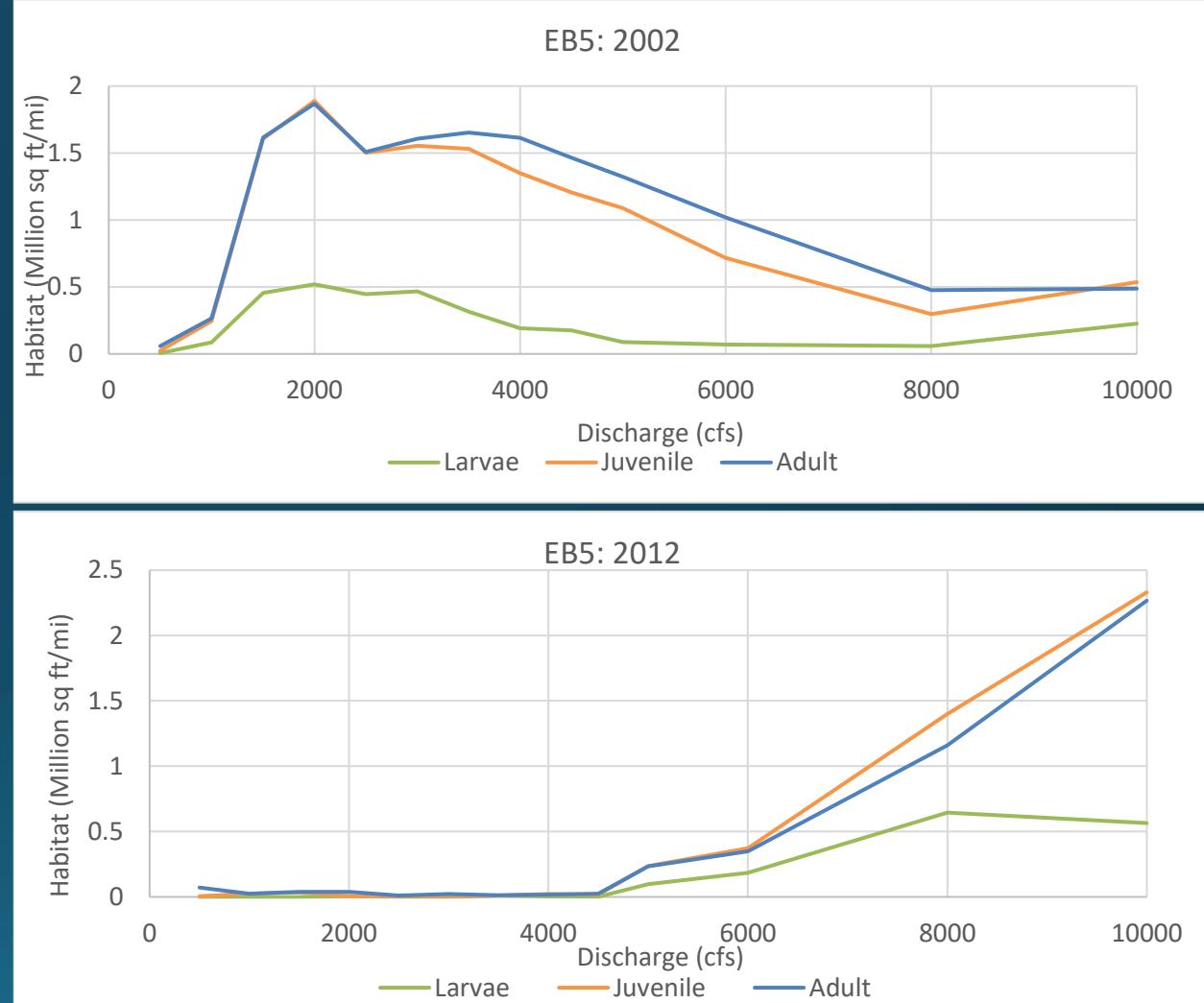




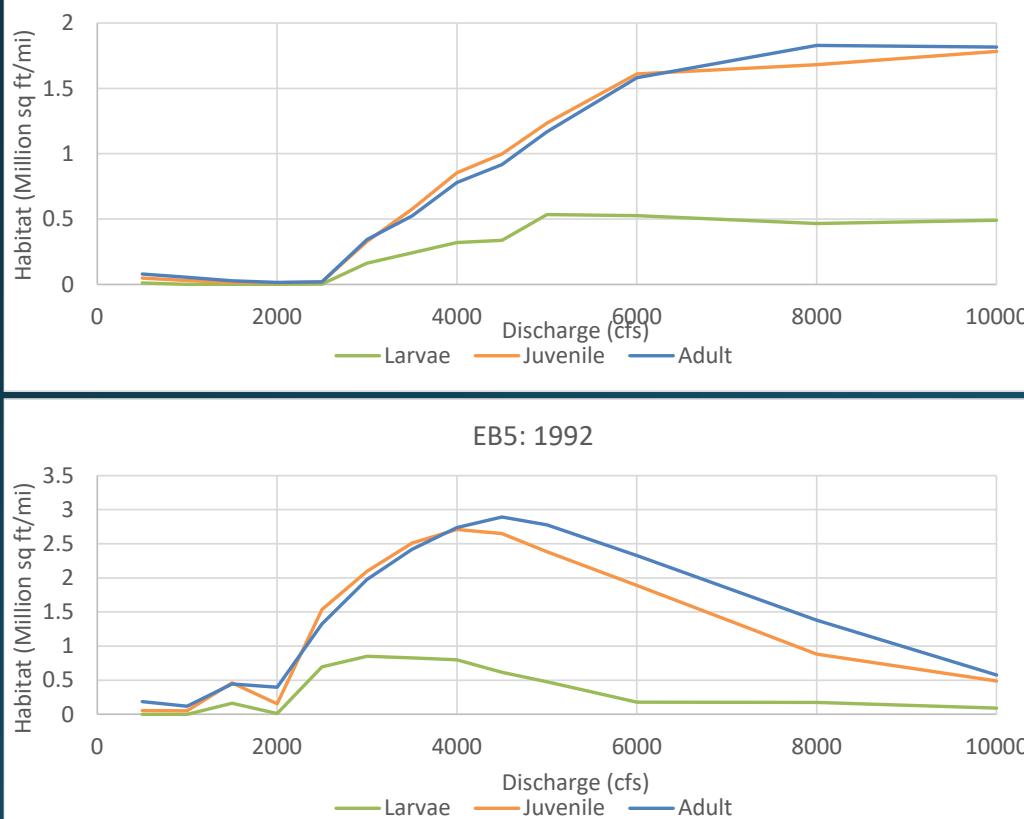
EB5: 1962



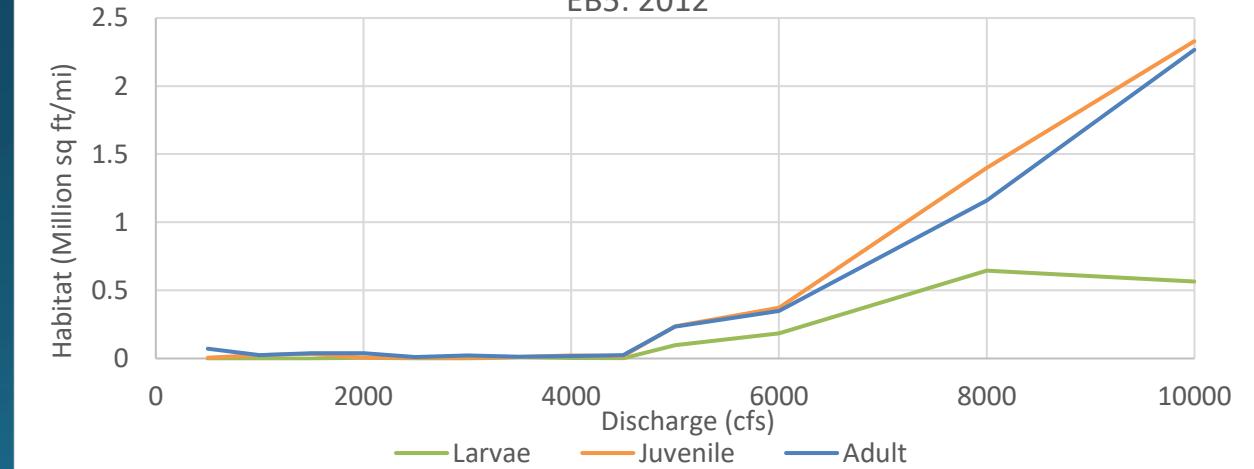
EB5: 2002



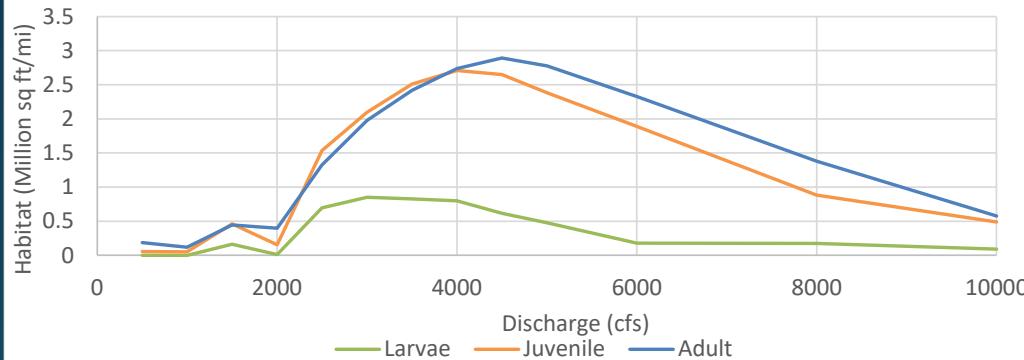
EB5: 1972

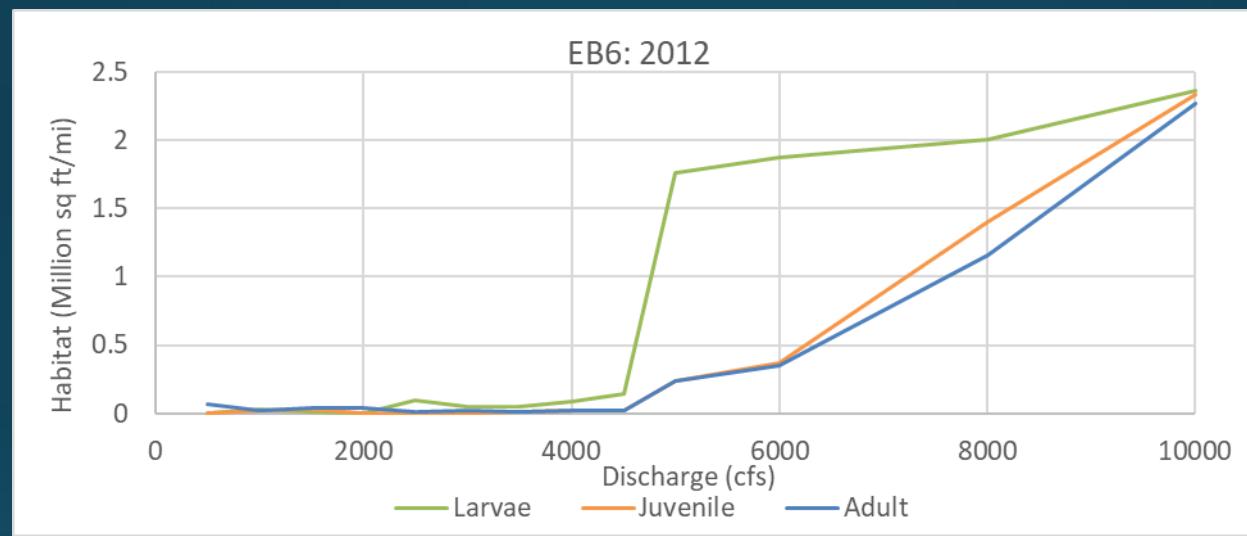


EB5: 2012



EB5: 1992



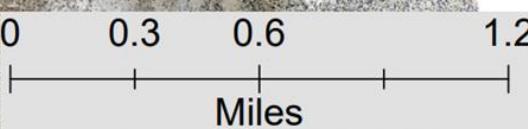


EB6.1 Habitat

1,500 cfs

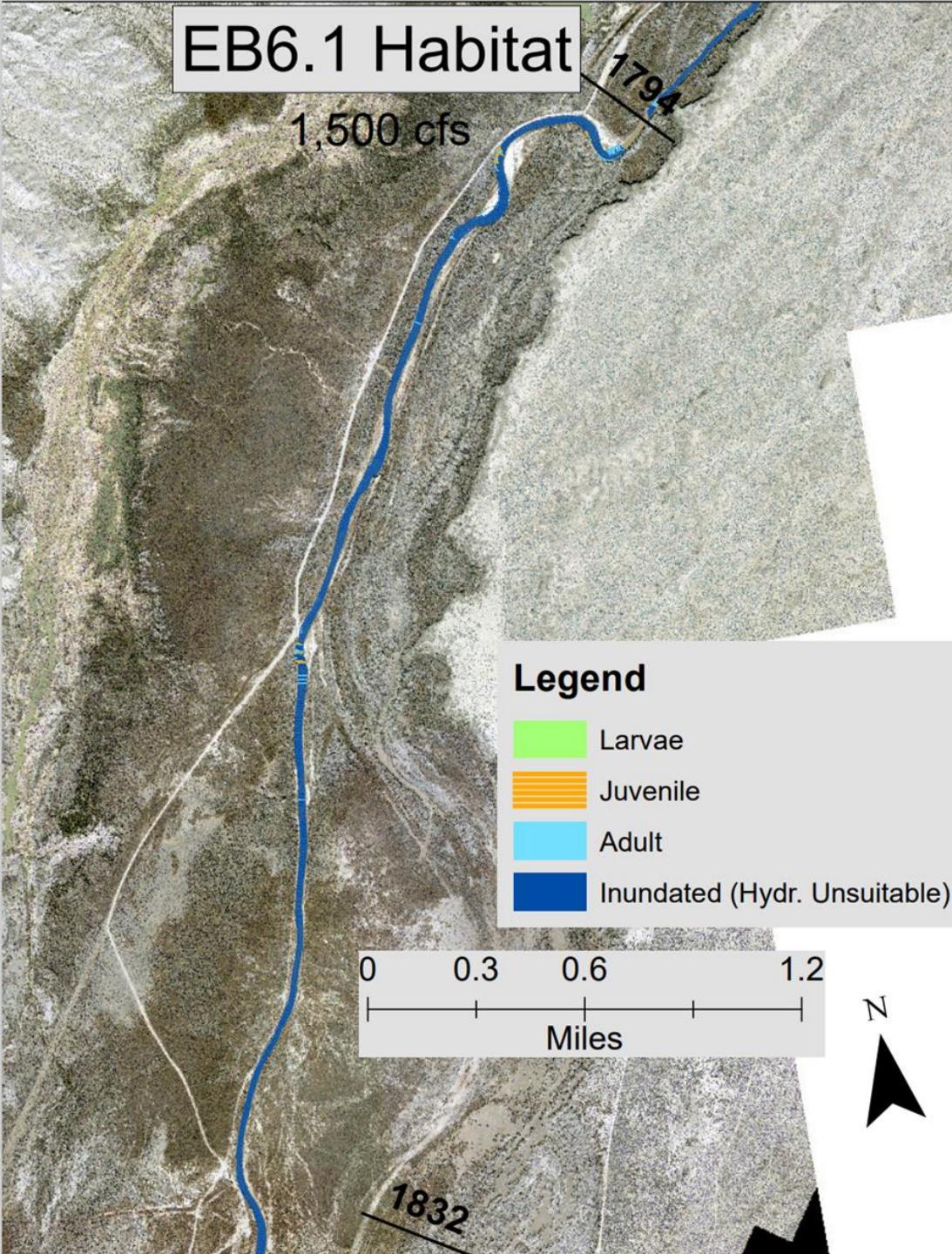
Legend

- Larvae
- Juvenile
- Adult
- Inundated (Hydr. Unsuitable)



N

1832



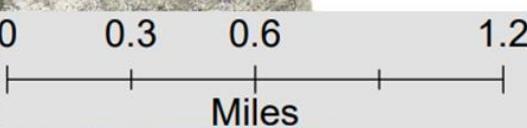
EB6.2 Habitat

1,500 cfs

1832

Legend

- Larvae
- Juvenile
- Adult
- Inundated (Hydr. Unsuitable)



N



1872

EB6.3 Habitat

1,500 cfs

1872

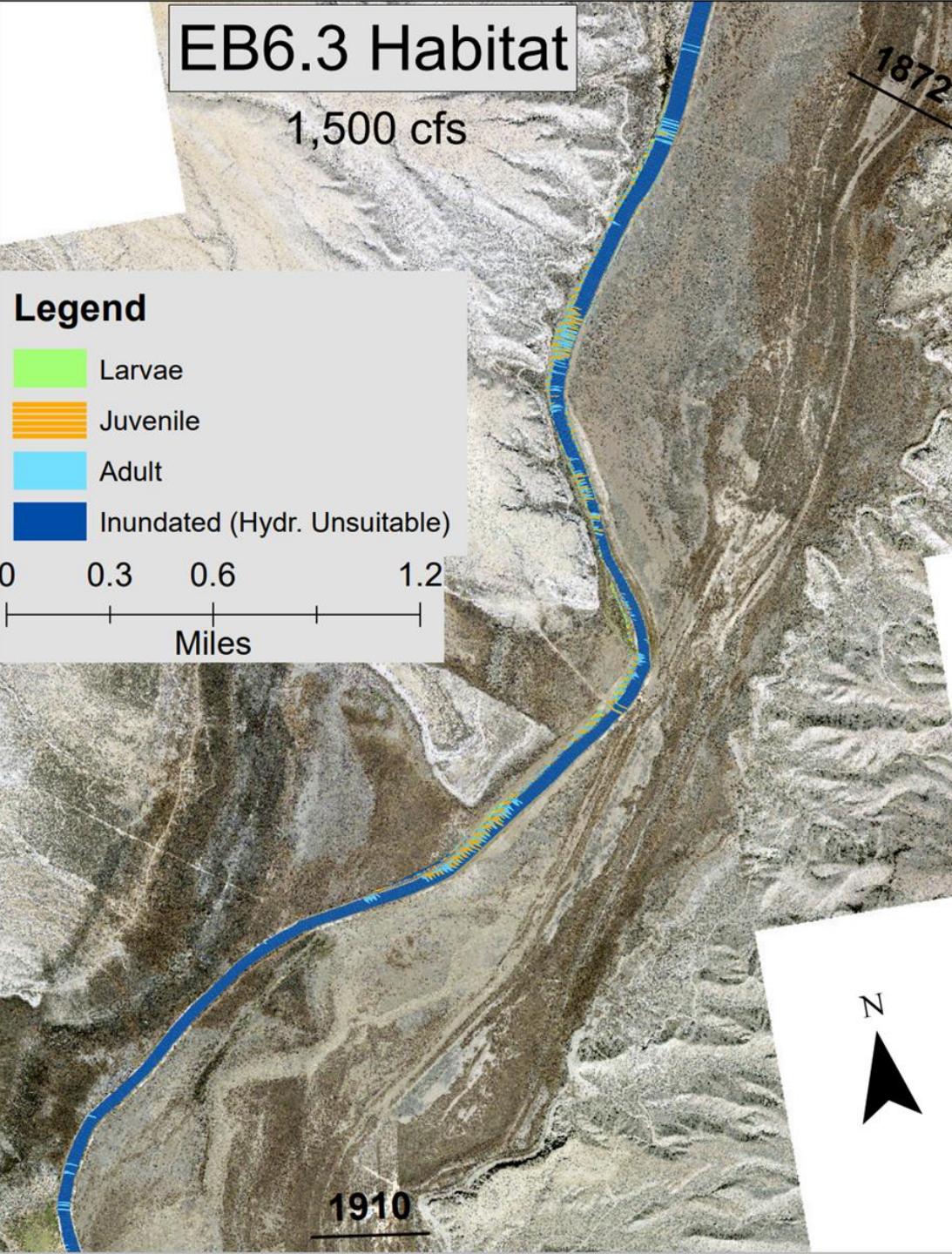
Legend

- Larvae
- Juvenile
- Adult
- Inundated (Hydr. Unsuitable)

0 0.3 0.6 1.2
Miles

N

1910



EB6.4 Habitat

1,500 cfs

1910

Legend

- Larvae
- Juvenile
- Adult
- Inundated (Hydr. Unsuitable)

0 0.3 0.6 1.2
Miles



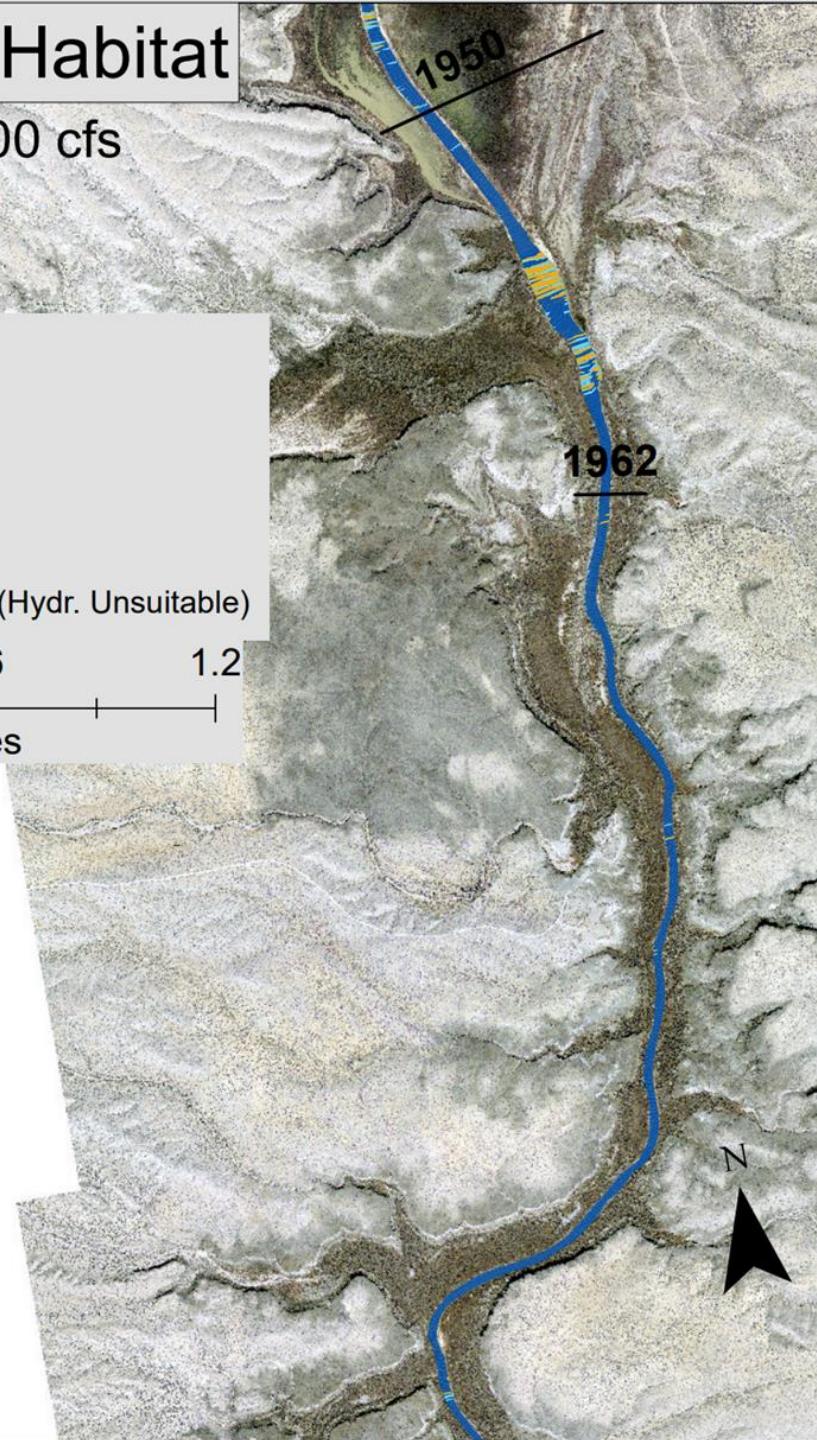
EB6.5 Habitat

1,500 cfs

Legend

- Larvae
- Juvenile
- Adult
- Inundated (Hydr. Unsuitable)

0 0.3 0.6 1.2
Miles



N

EB6.6 Habitat

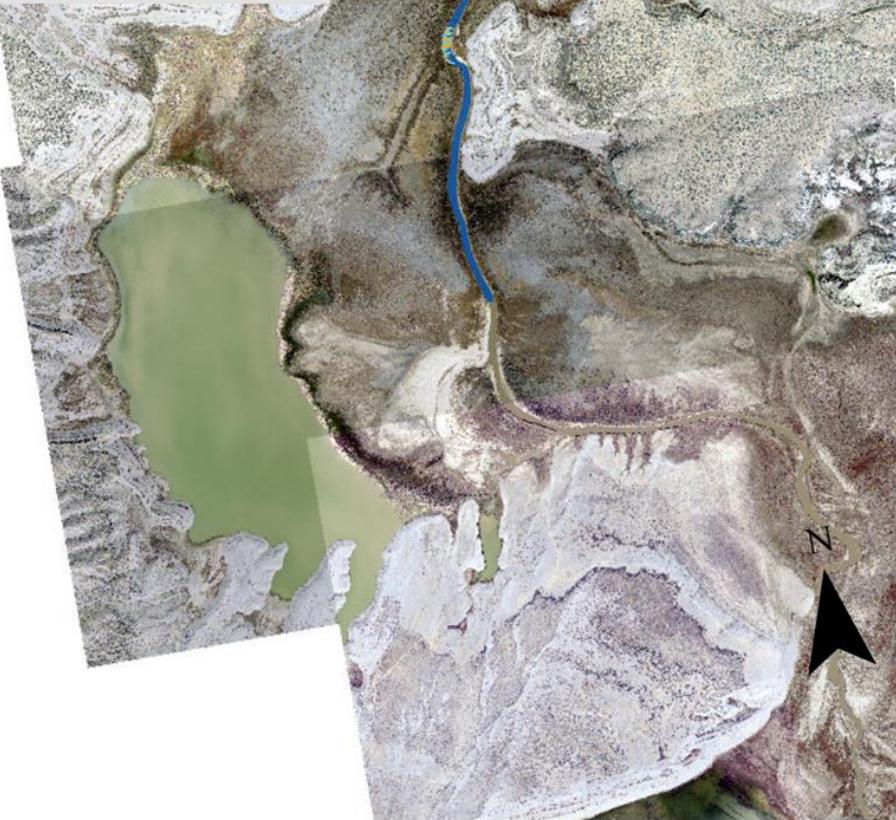
1,500 cfs

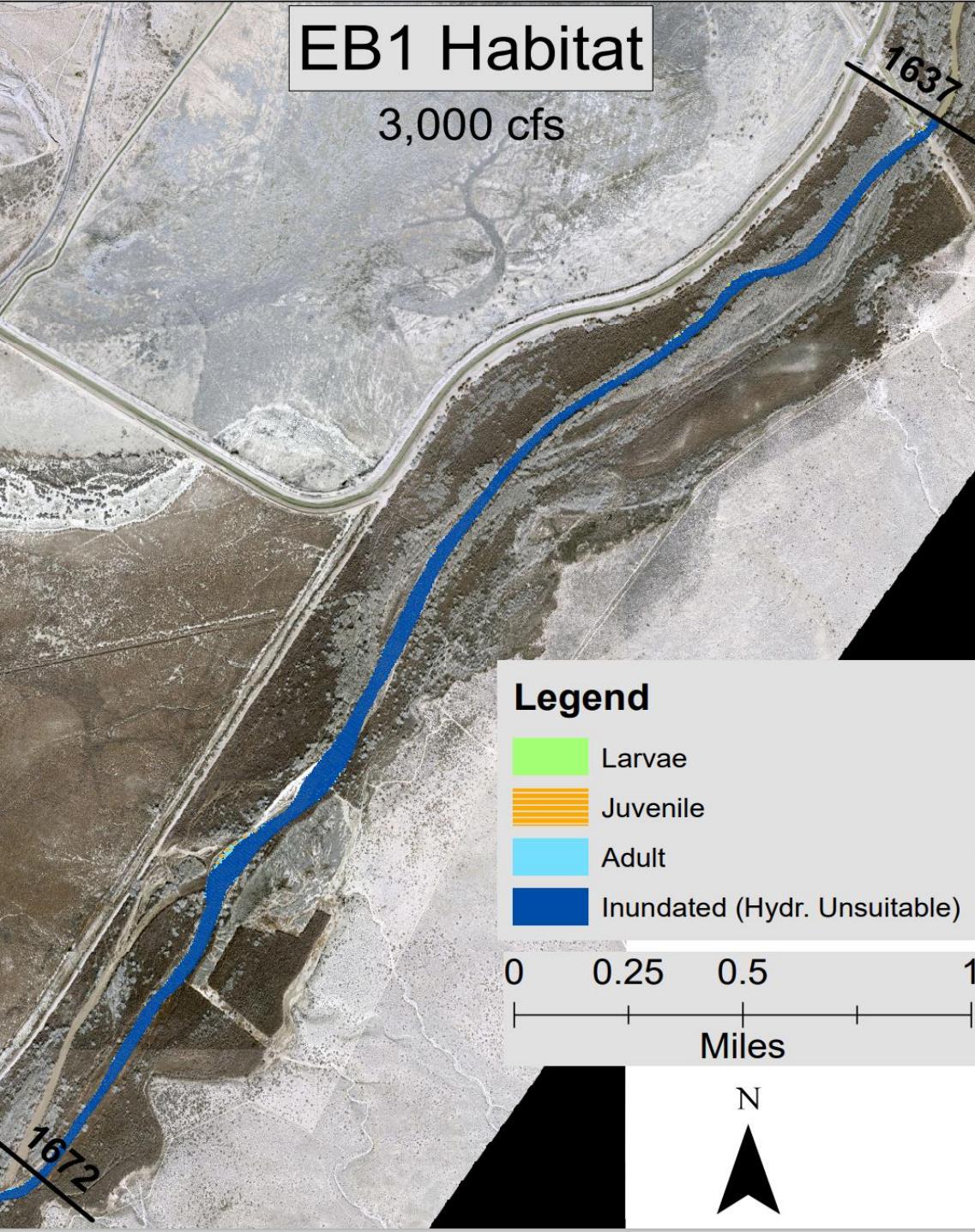
Legend

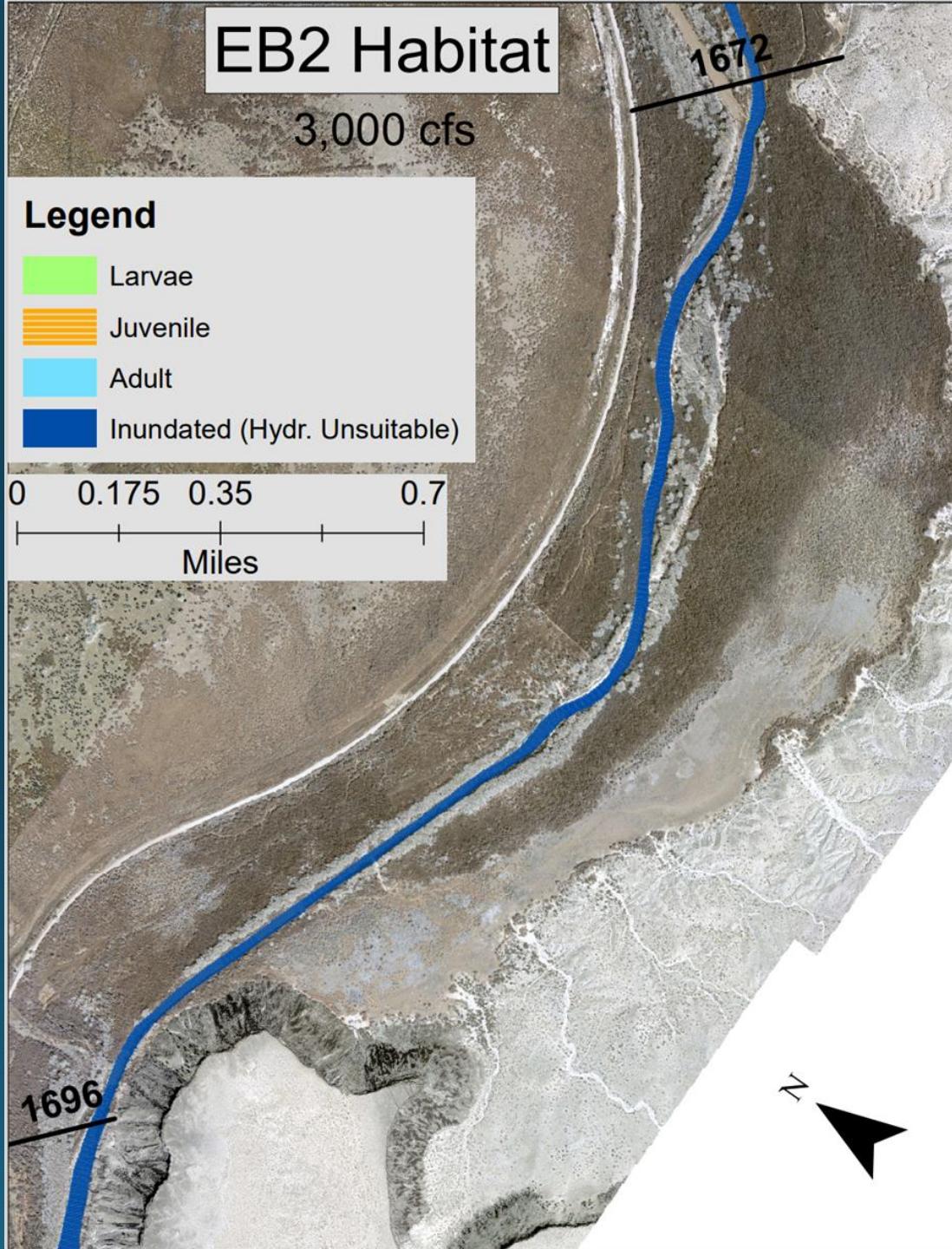
- Larvae
- Juvenile
- Adult
- Inundated (Hydr. Unsuitable)

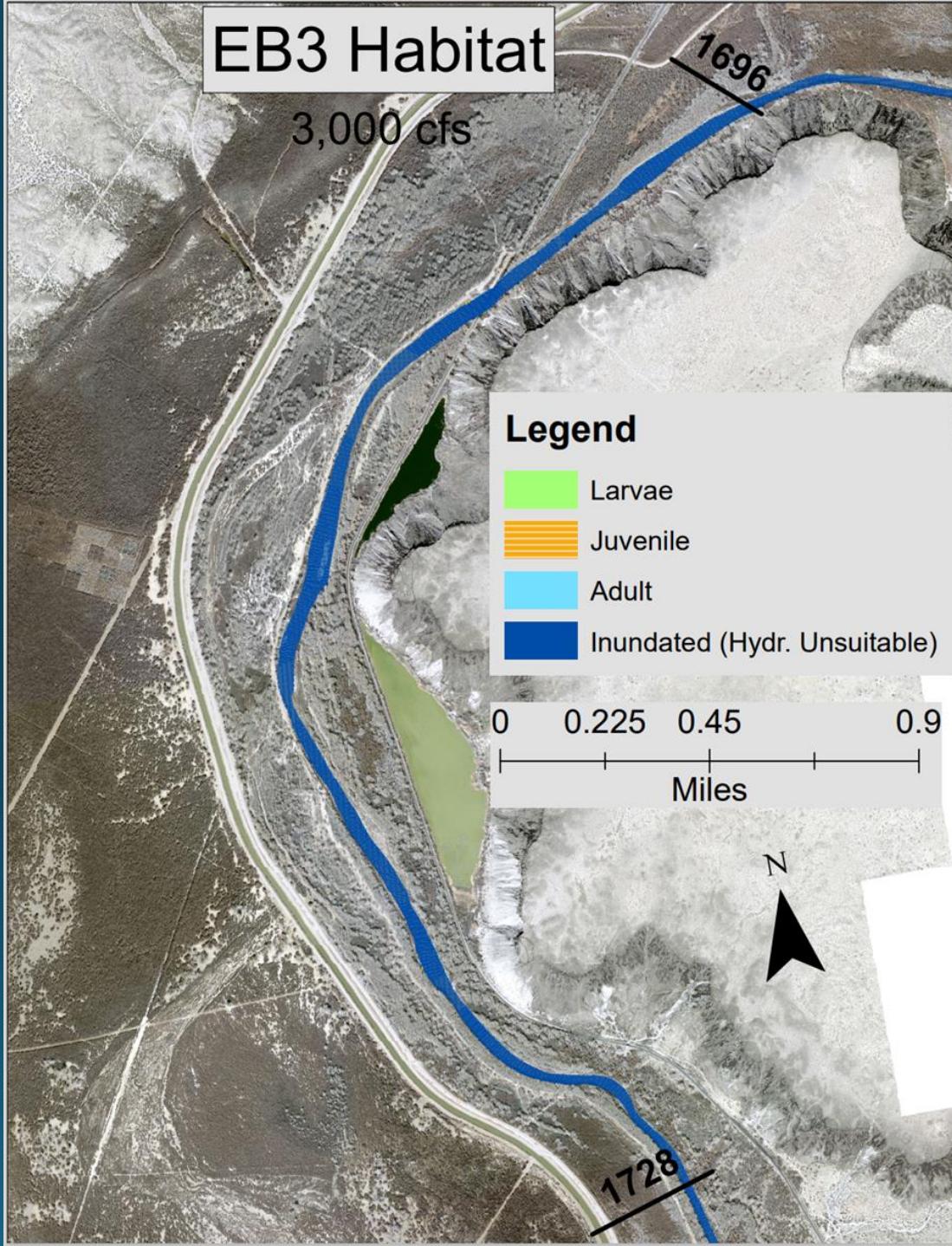
0 0.3 0.6 1.2

Miles









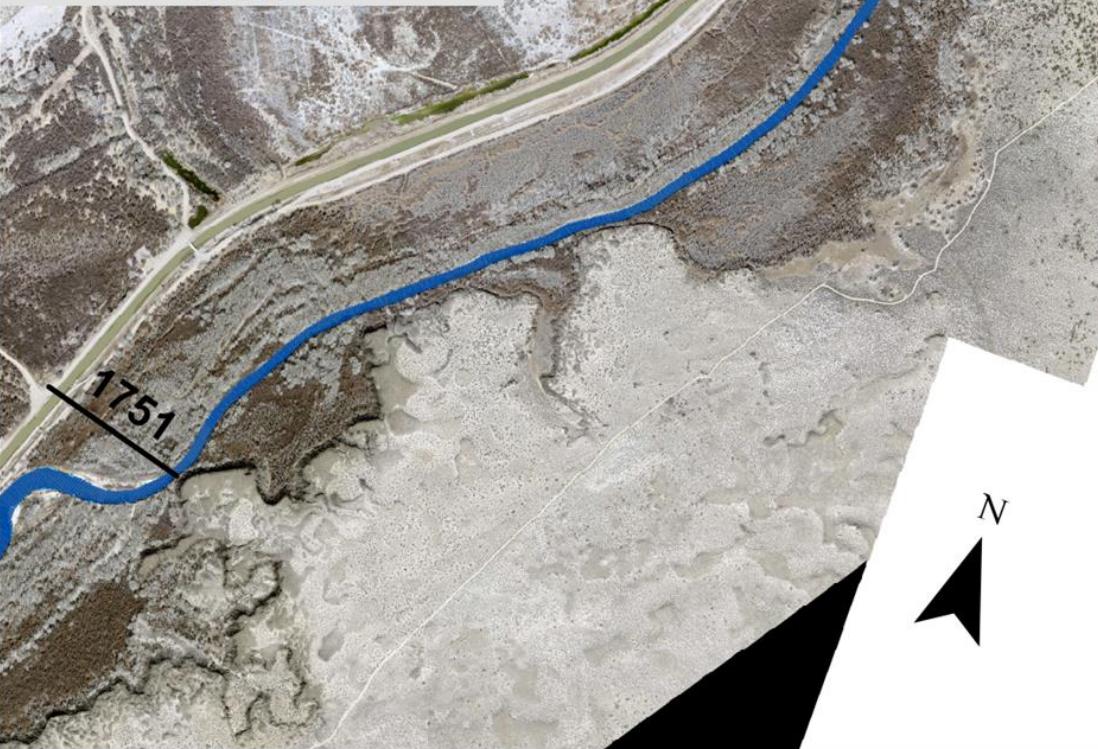
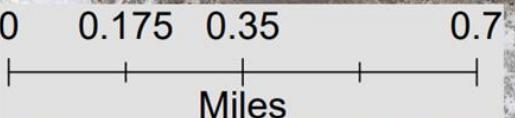
EB4 Habitat

3,000 cfs

1728

Legend

- Larvae
- Juvenile
- Adult
- Inundated (Hydr. Unsuitable)



EB5 Habitat

3,000 cfs

Legend

- Larvae
- Juvenile
- Adult
- Inundated (Hydr. Unsuitable)

0 0.3 0.6 1.2
Miles



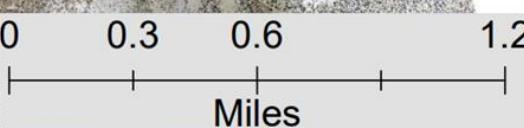
EB6.1 Habitat

3,000 cfs

794

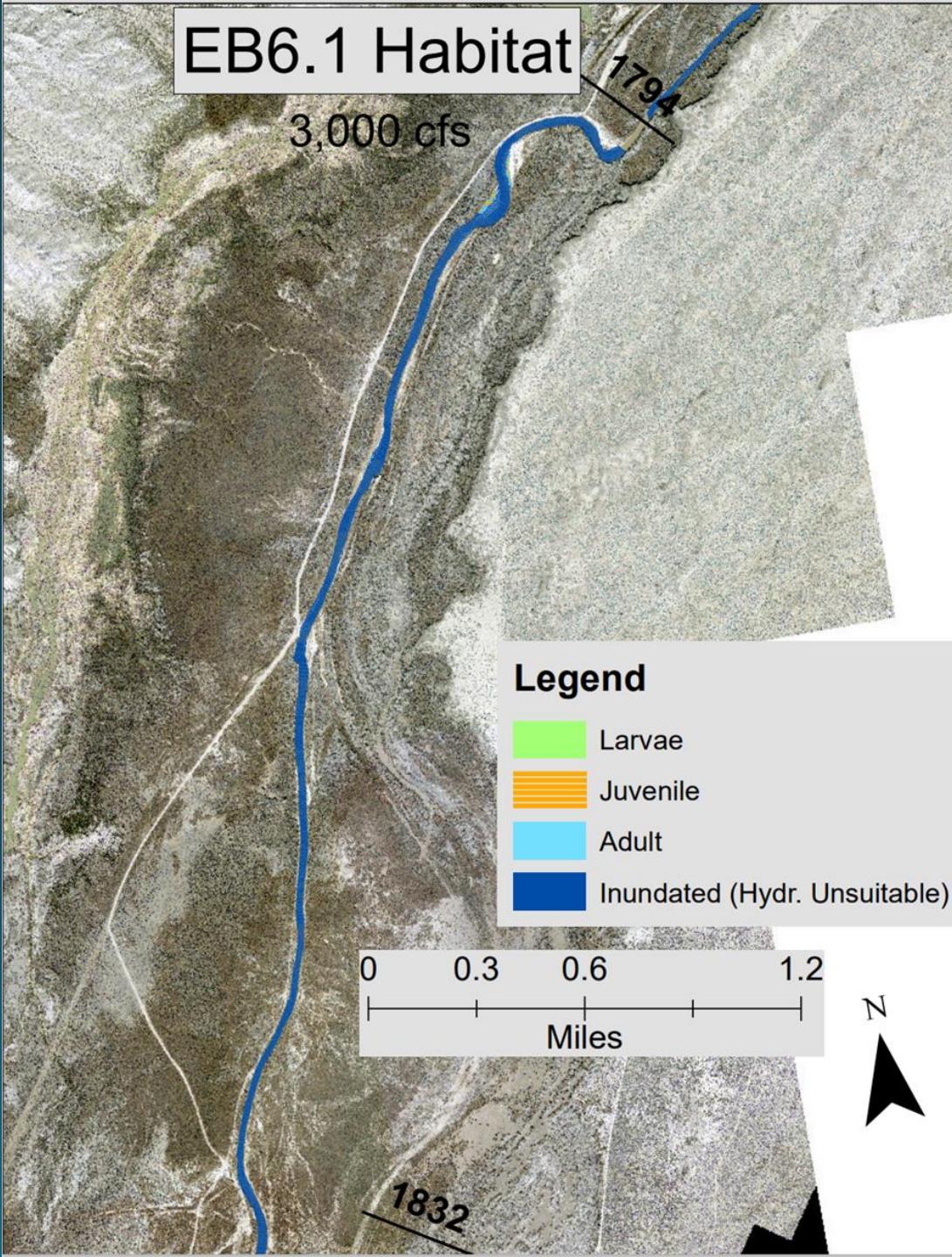
Legend

- Larvae
- Juvenile
- Adult
- Inundated (Hydr. Unsuitable)



N

1832



EB6.2 Habitat

3,000 cfs

1832

Legend

- Larvae
- Juvenile
- Adult
- Inundated (Hydr. Unsuitable)

0 0.3 0.6 1.2
Miles

N



1872

EB6.3 Habitat

3,000 cfs

1872

Legend

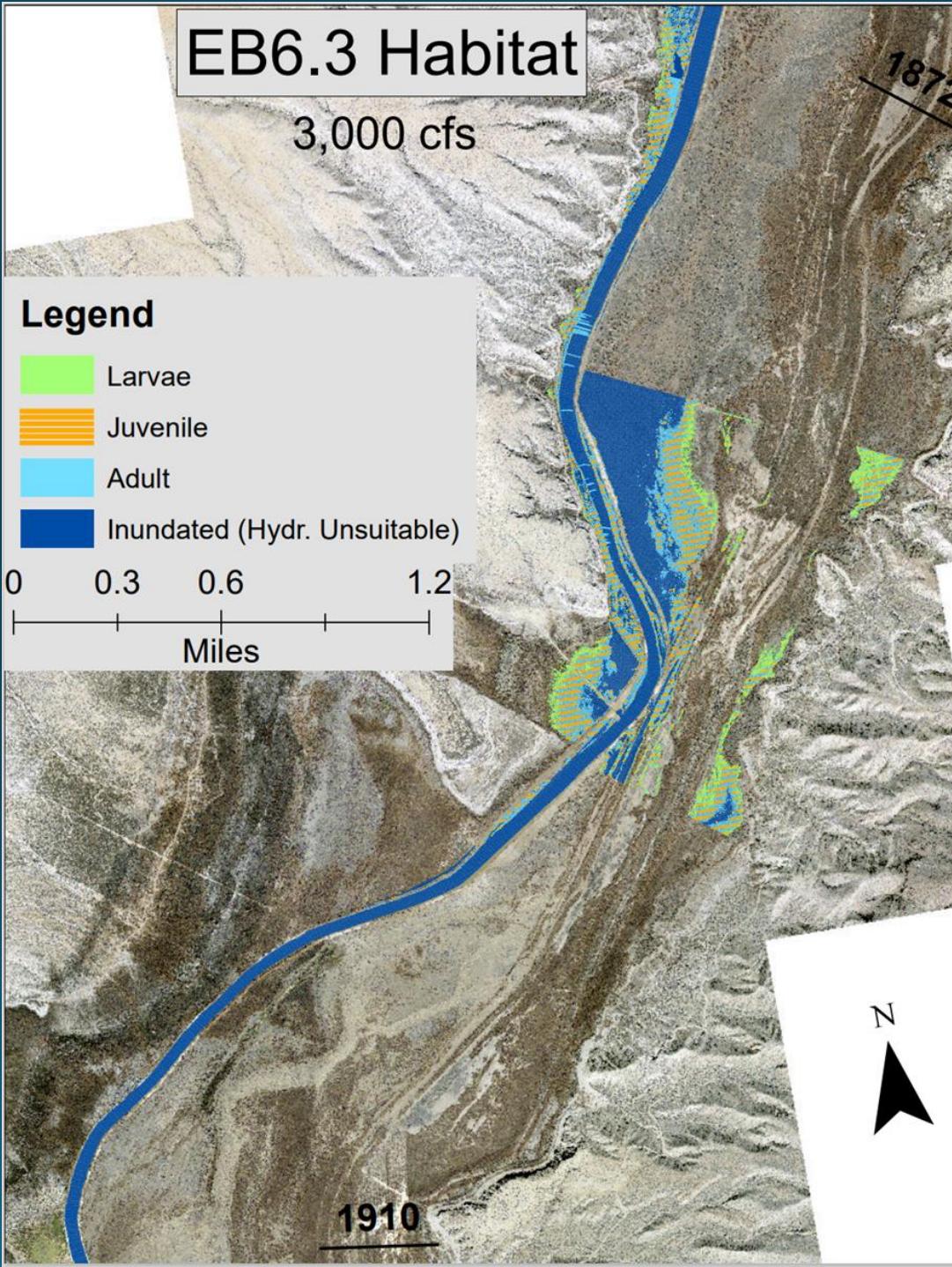
- Larvae
- Juvenile
- Adult
- Inundated (Hydr. Unsuitable)

0 0.3 0.6 1.2
Miles

N



1910



EB6.4 Habitat

1910

3,000 cfs

Legend

- Larvae
- Juvenile
- Adult
- Inundated (Hydr. Unsuitable)

0 0.3 0.6 1.2
Miles



EB6.5 Habitat

3,000 cfs

Legend

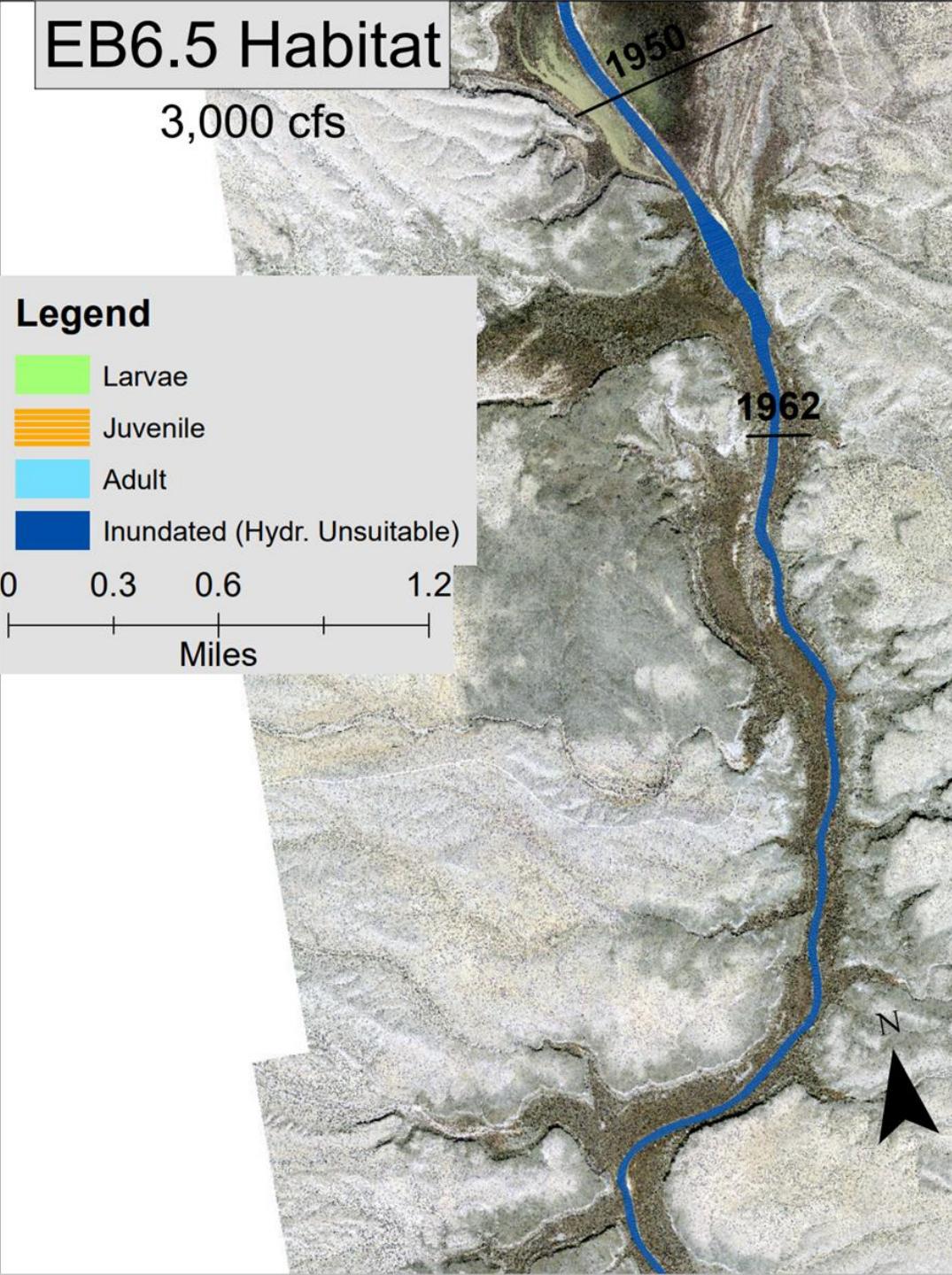
- Larvae
- Juvenile
- Adult
- Inundated (Hydr. Unsuitable)

0 0.3 0.6 1.2
Miles

1950

1962

N



EB6.6 Habitat

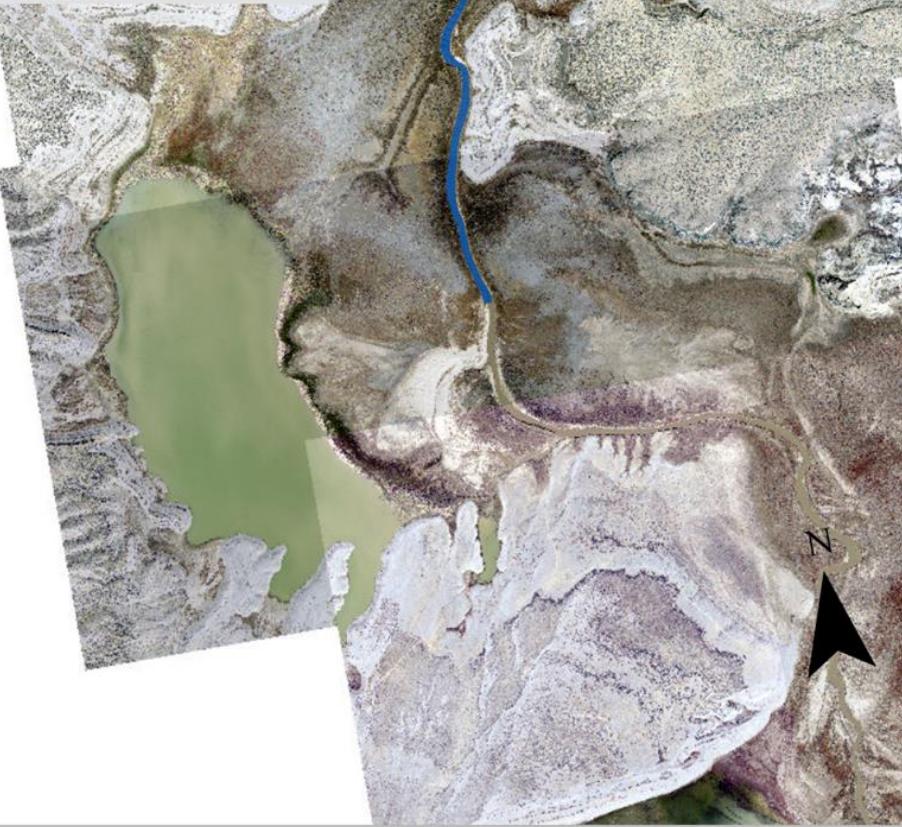
3,000 cfs

Legend

- Larvae
- Juvenile
- Adult
- Inundated (Hydr. Unsuitable)

0 0.3 0.6 1.2

Miles



EB1 Habitat

5,000 cfs

1637

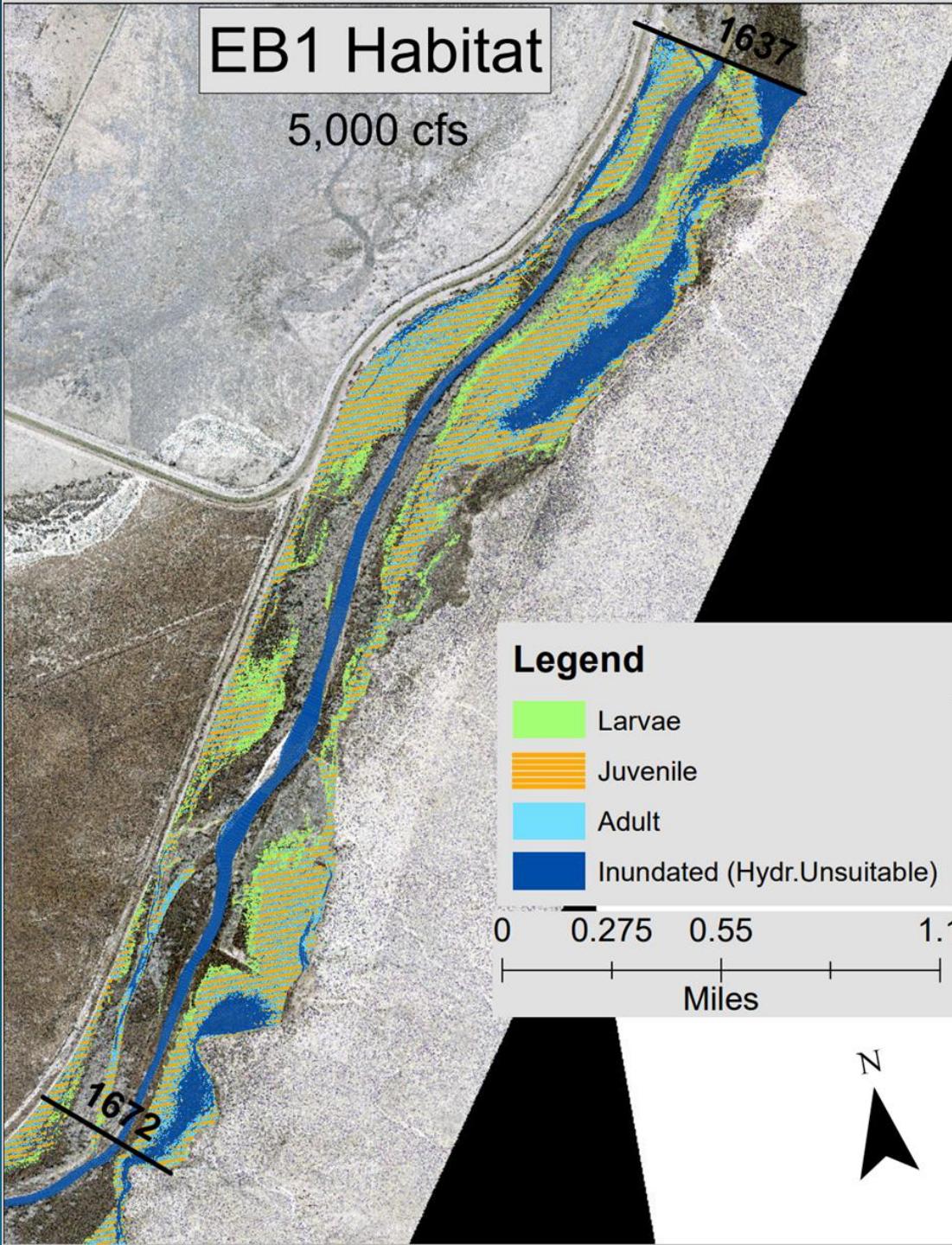
Legend

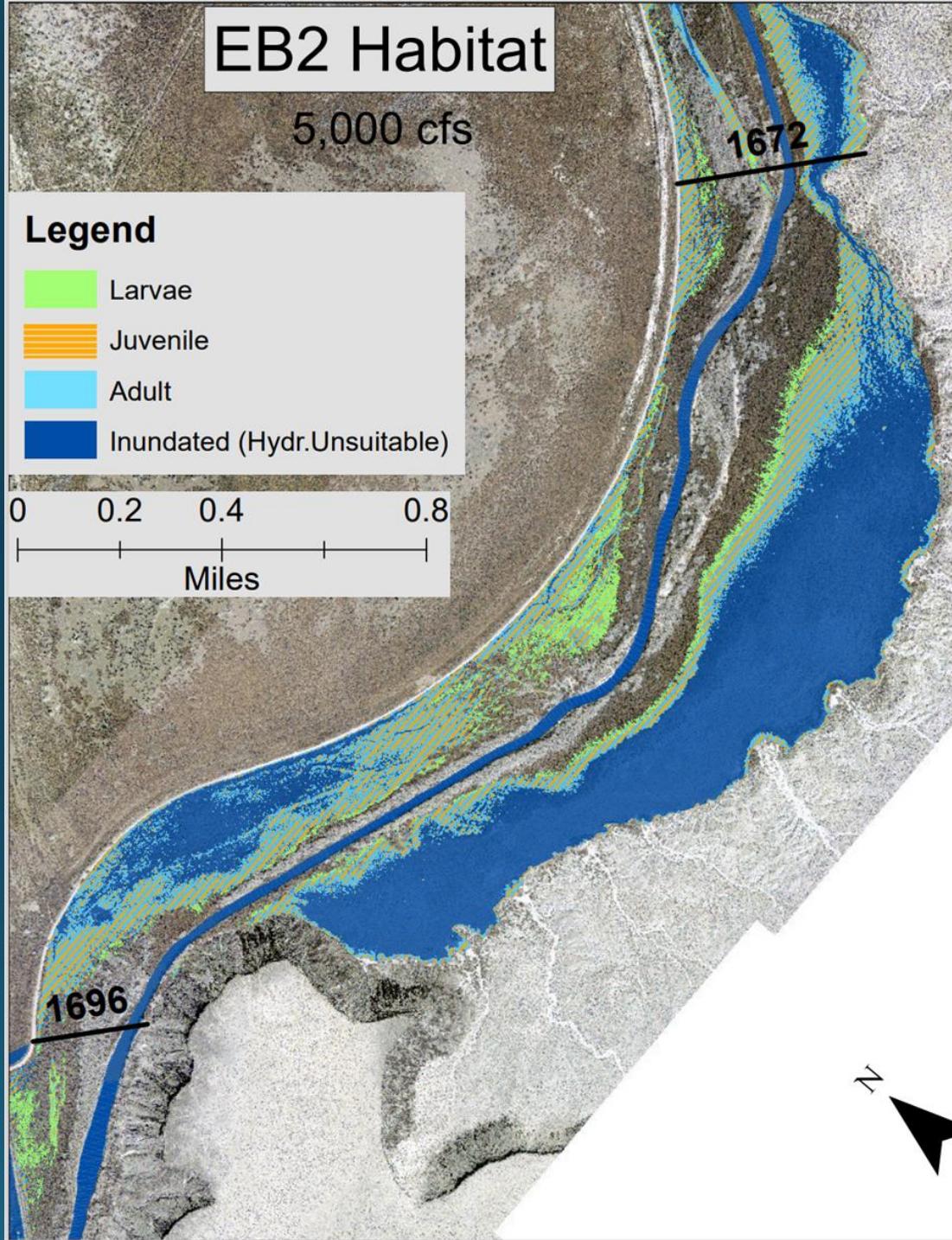
- Larvae
- Juvenile
- Adult
- Inundated (Hydr.Unsuitable)

0 0.275 0.55 1.1
Miles

N

1672





EB3 Habitat

5,000 cfs

1696

Legend

- Larvae
- Juvenile
- Adult
- Inundated (Hydr.Unsuitable)

0 0.225 0.45 0.9
Miles

N



1728

EB4 Habitat

5,000 cfs

Legend

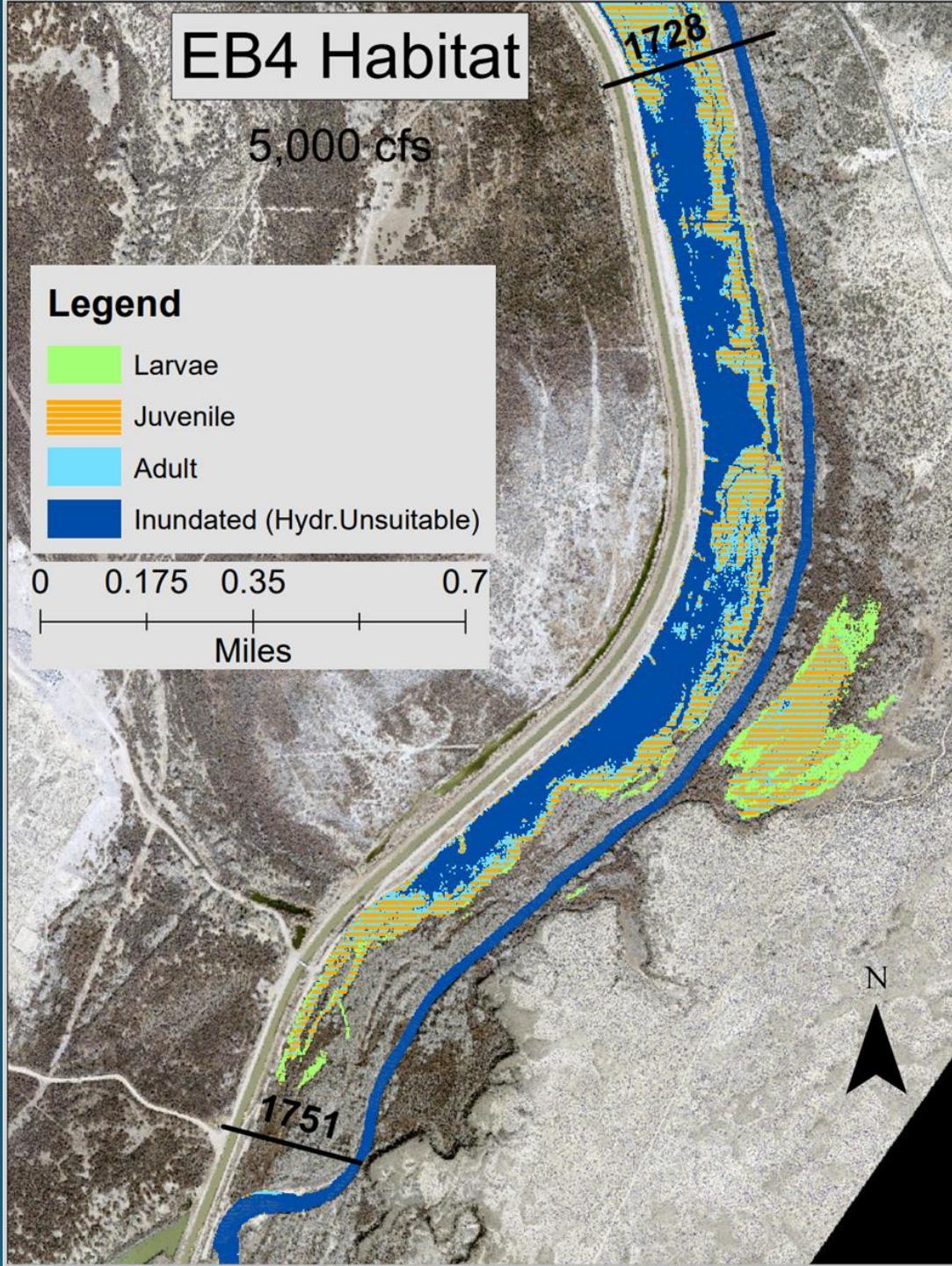
- Larvae
- Juvenile
- Adult
- Inundated (Hydr.Unsuitable)

0 0.175 0.35 0.7
Miles

1728

1751

N



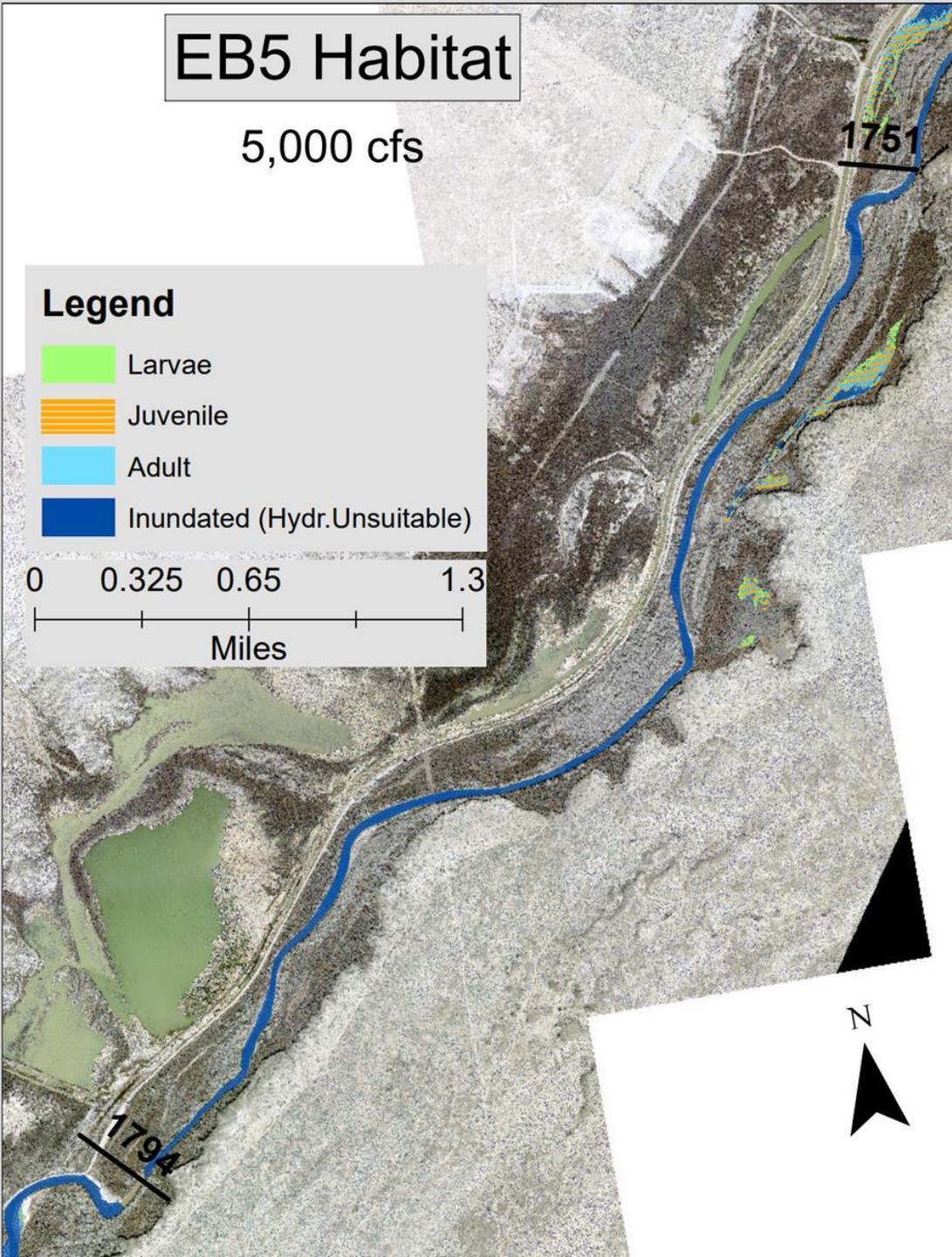
EB5 Habitat

5,000 cfs

Legend

- Larvae
- Juvenile
- Adult
- Inundated (Hydr.Unsuitable)

0 0.325 0.65 1.3
Miles

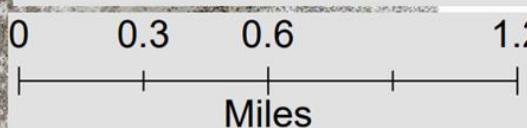


EB6.1 Habitat

5,000 cfs

Legend

- Larvae
- Juvenile
- Adult
- Inundated (Hydr.Unsuitable)



1794
1832

N

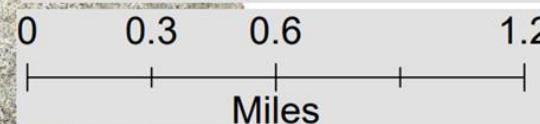
EB6.2 Habitat

5,000 cfs

1832

Legend

- Larvae
- Juvenile
- Adult
- Inundated (Hydr.Unsuitable)



N



1872

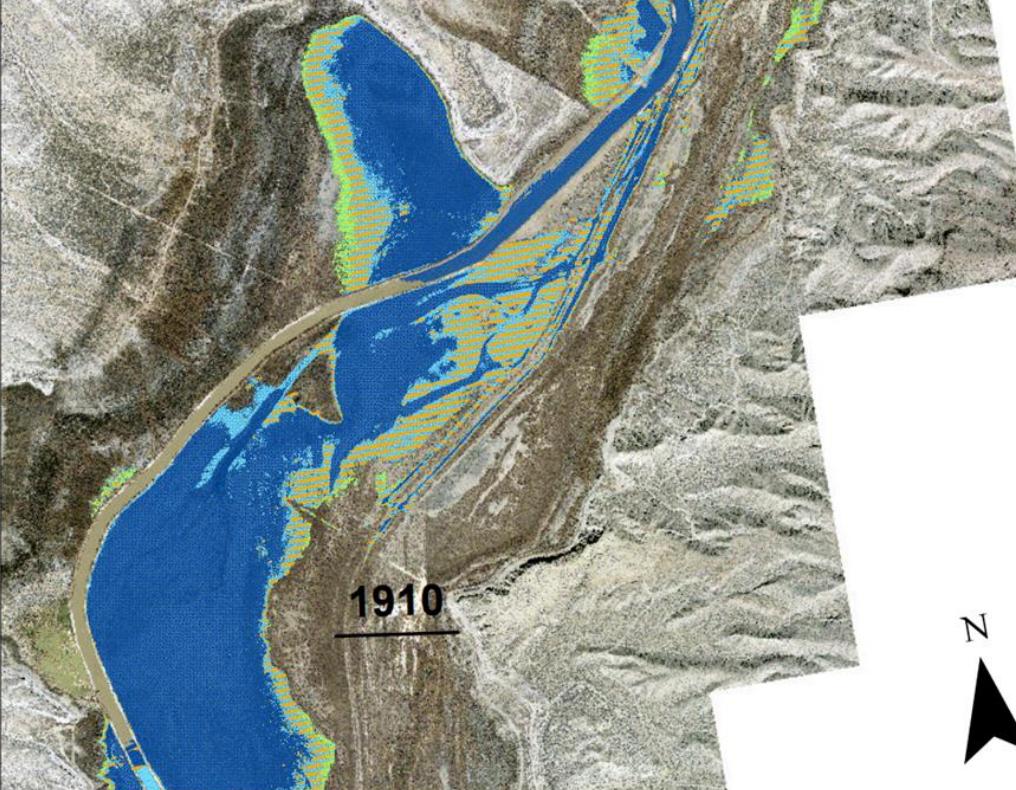
EB6.3 Habitat

5,000 cfs

Legend

- Larvae
- Juvenile
- Adult
- Inundated (Hydr.Unsuitable)

0 0.325 0.65 1.3
Miles



EB6.4 Habitat

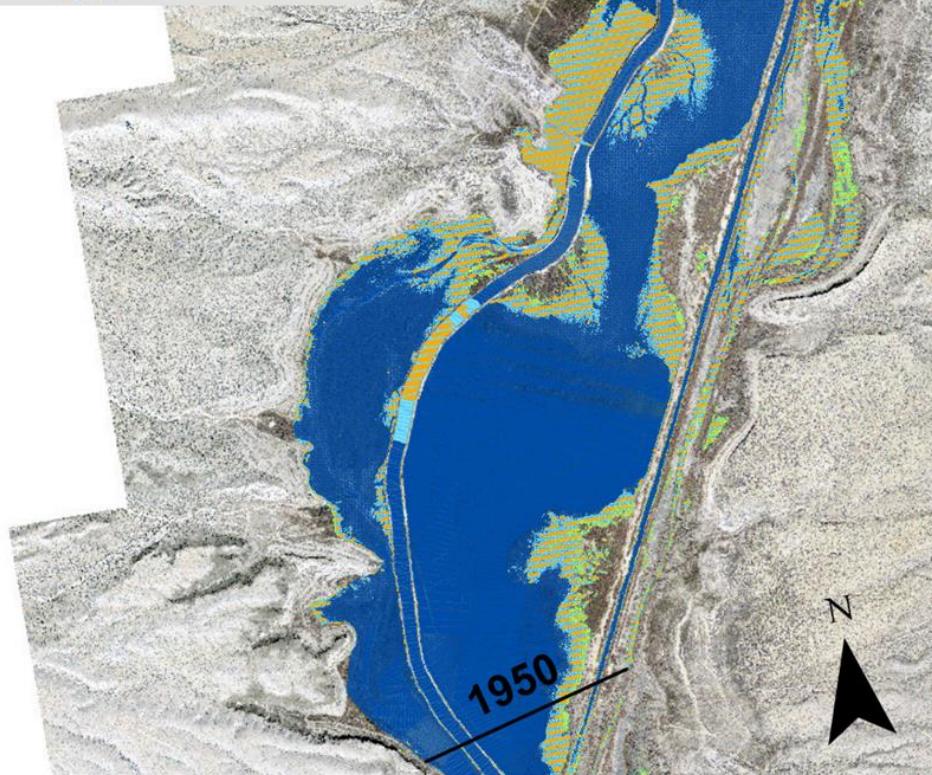
5,000 cfs

1910

Legend

- Larvae
- Juvenile
- Adult
- Inundated (Hydr.Unsuitable)

0 0.325 0.65 1.3
Miles



EB6.5 Habitat

5,000 cfs

Legend

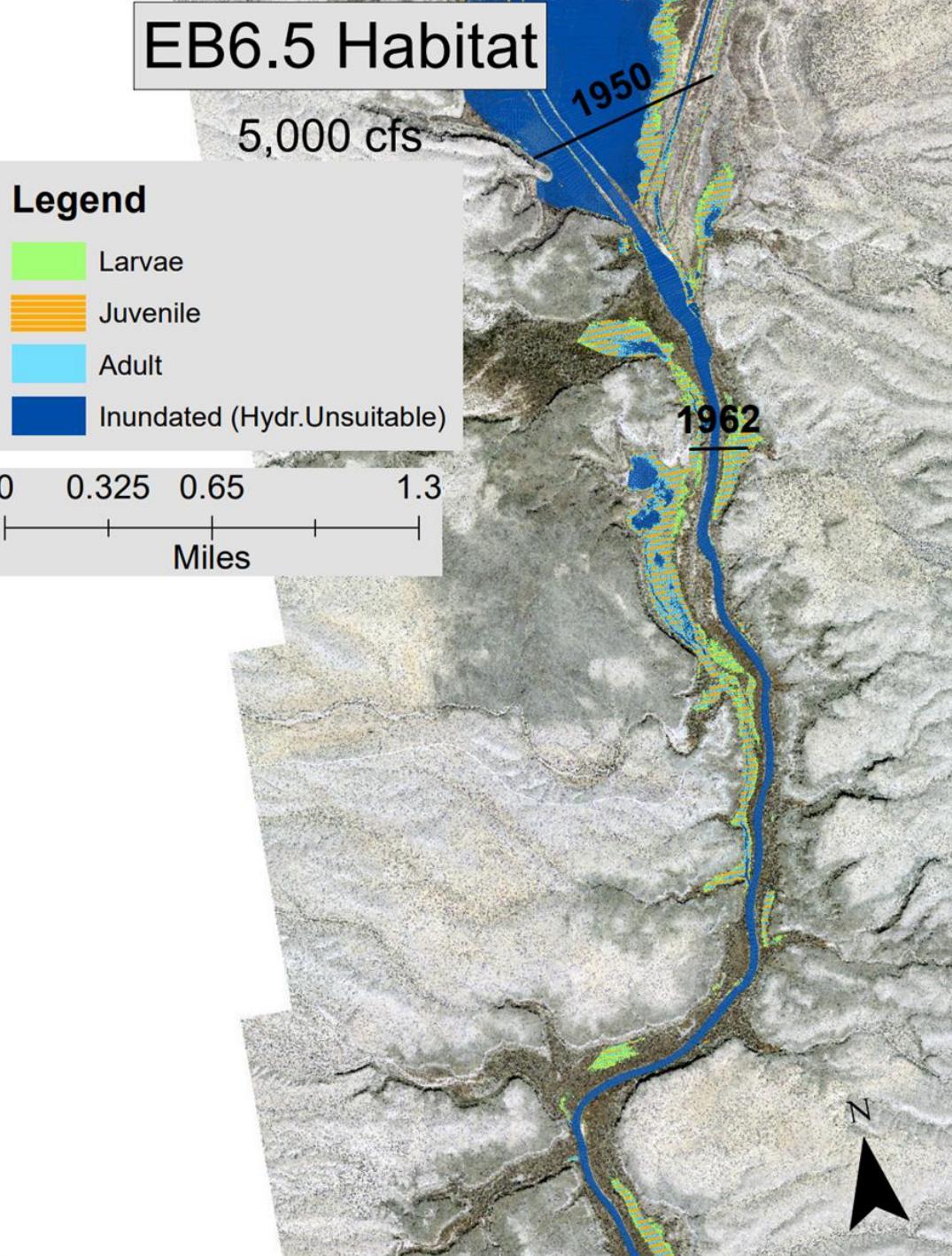
- Larvae
- Juvenile
- Adult
- Inundated (Hydr.Unsuitable)

0 0.325 0.65 1.3
Miles

1950

1962

N



EB6.6 Habitat

5,000 cfs

Legend

- Larvae
- Juvenile
- Adult
- Inundated (Hydr.Unsuitable)

