Process Linkage Report Update

CSU/UNM/ASIR Meeting

March 23, 2020

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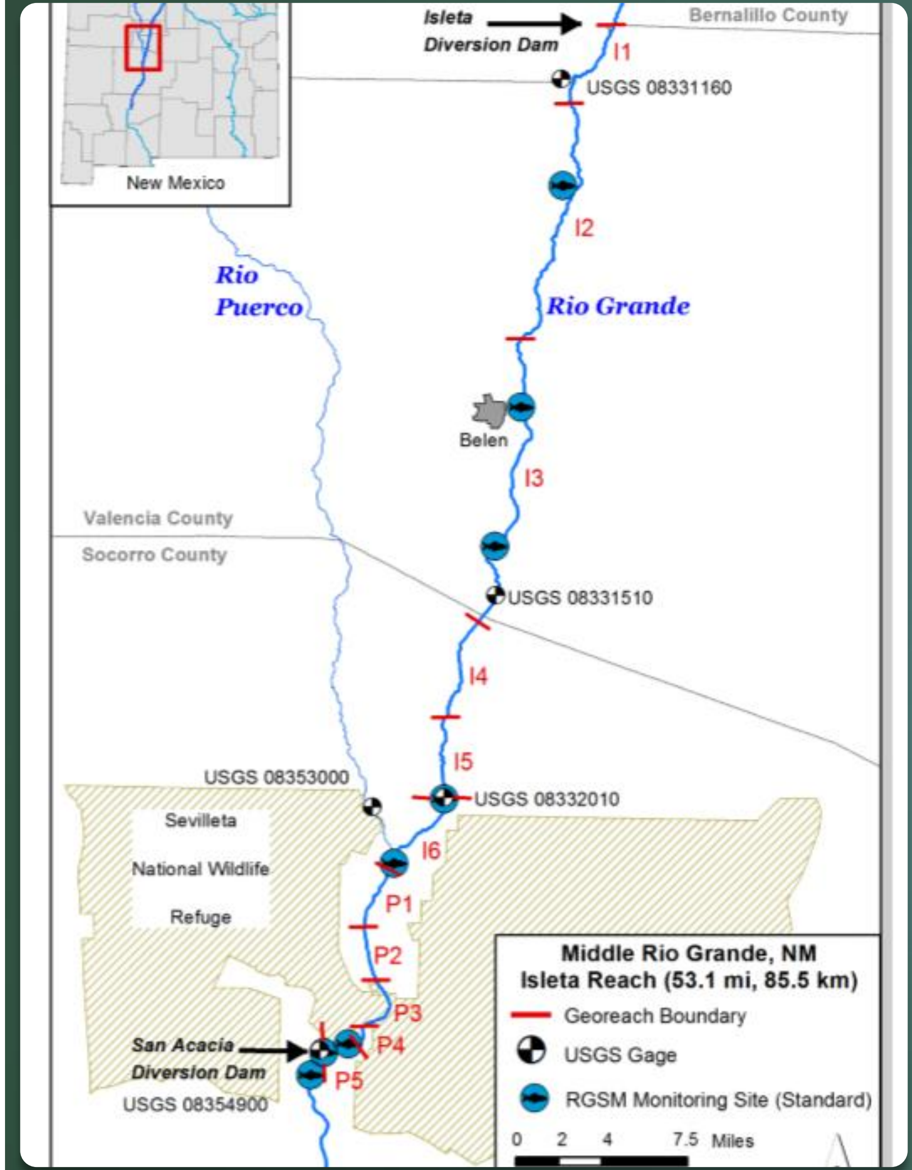
Contents



From Isleta Diversion Dam to San Acacia Diversion Dam

Total length = 53.1 mi

Isleta:

- Sub-reaches I1-I6

Rio Puerco:

- Sub-reaches P1 – P5

Map Delineations

Sub-reach	Agg/Deg
I1	657-700
I2a	700-760
I2b	760-815
I3a	815-875
I3b	875-920
I3c	920-964
I4	964-1015
I5	1015-1053
I6	1053-1097
P1	1097-1126
P2	1126-1151
P3	1151-1182
P4	1182-1191
P5	1191-1206

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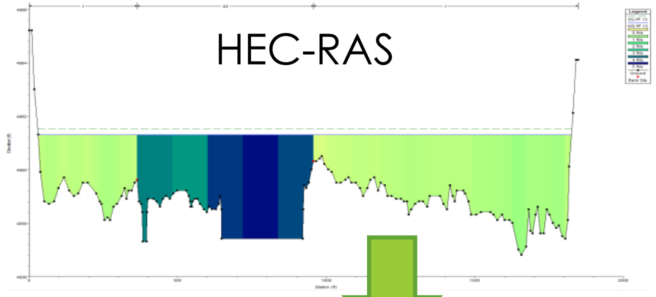
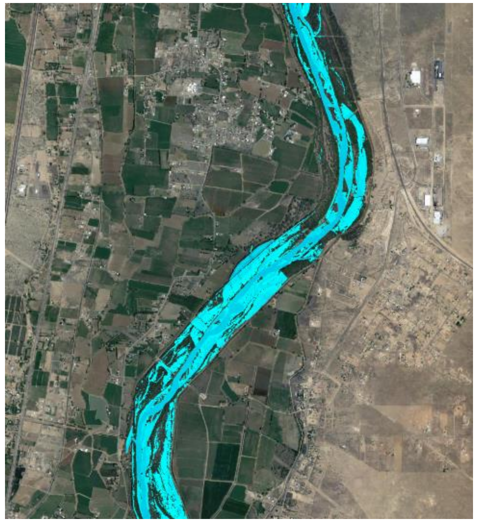
Hydraulic Modeling Methods



HEC-RAS



RAS Mapper (2012)

1-D modeling

Years 1962, ‘72, ‘92, 2002,’12
Q = 0-5,000 cfs at 500 cfs increment
+ 6k, 8k and 10k cfs

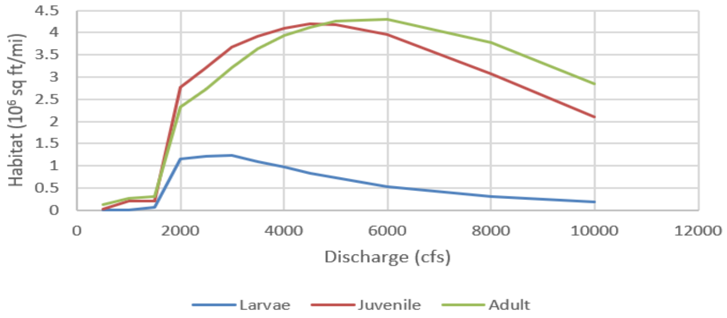
Stage	Velocity (cm/s)	Depth (cm)
Larvae	0-5	0-15
Juvenile	0-30	1-50
Adult	0-40	5-60

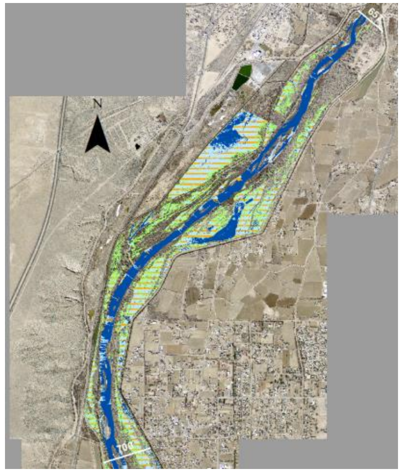
1-D model + 2-D mapping

Year 2012
Q = 1,500, 3,000 and 5,000 cfs

Stage	Velocity (cm/s)	Depth (cm)
Larvae	0-5	0-15
Juvenile	0-30	1-50
Adult	0-40	5-60

Habitat Curves

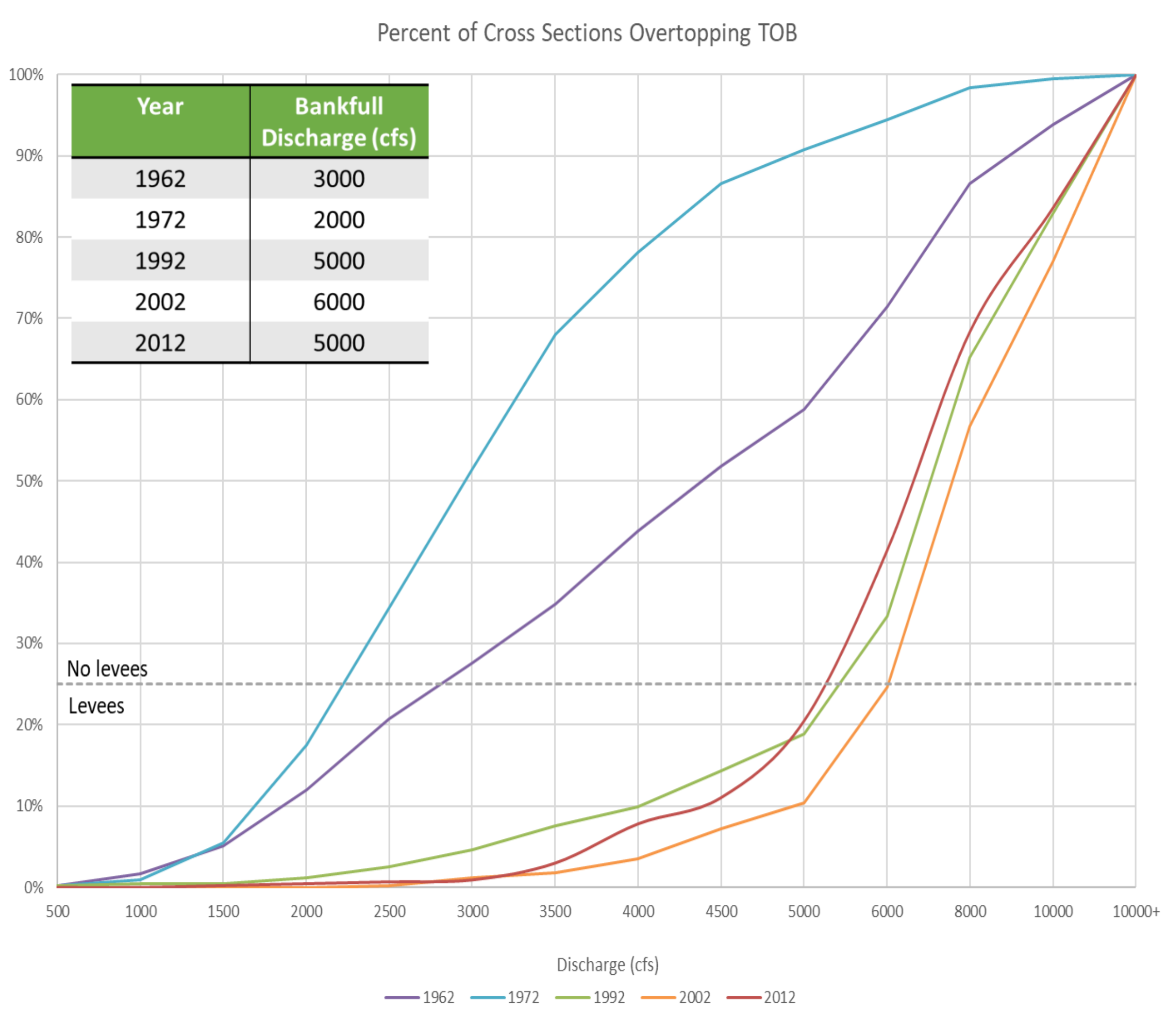




Habitat Maps (2012)

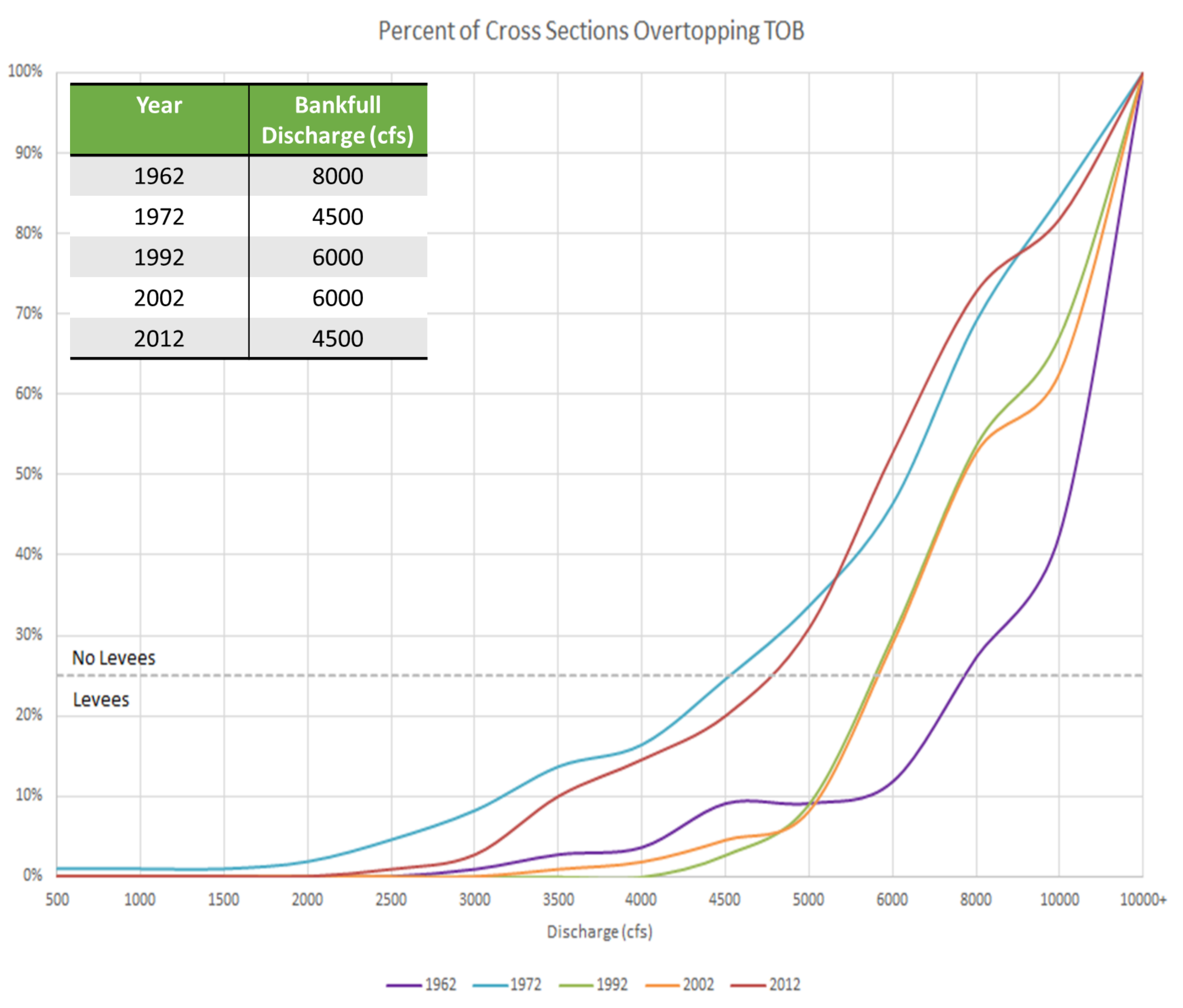
Overtopping Discharge

Isleta



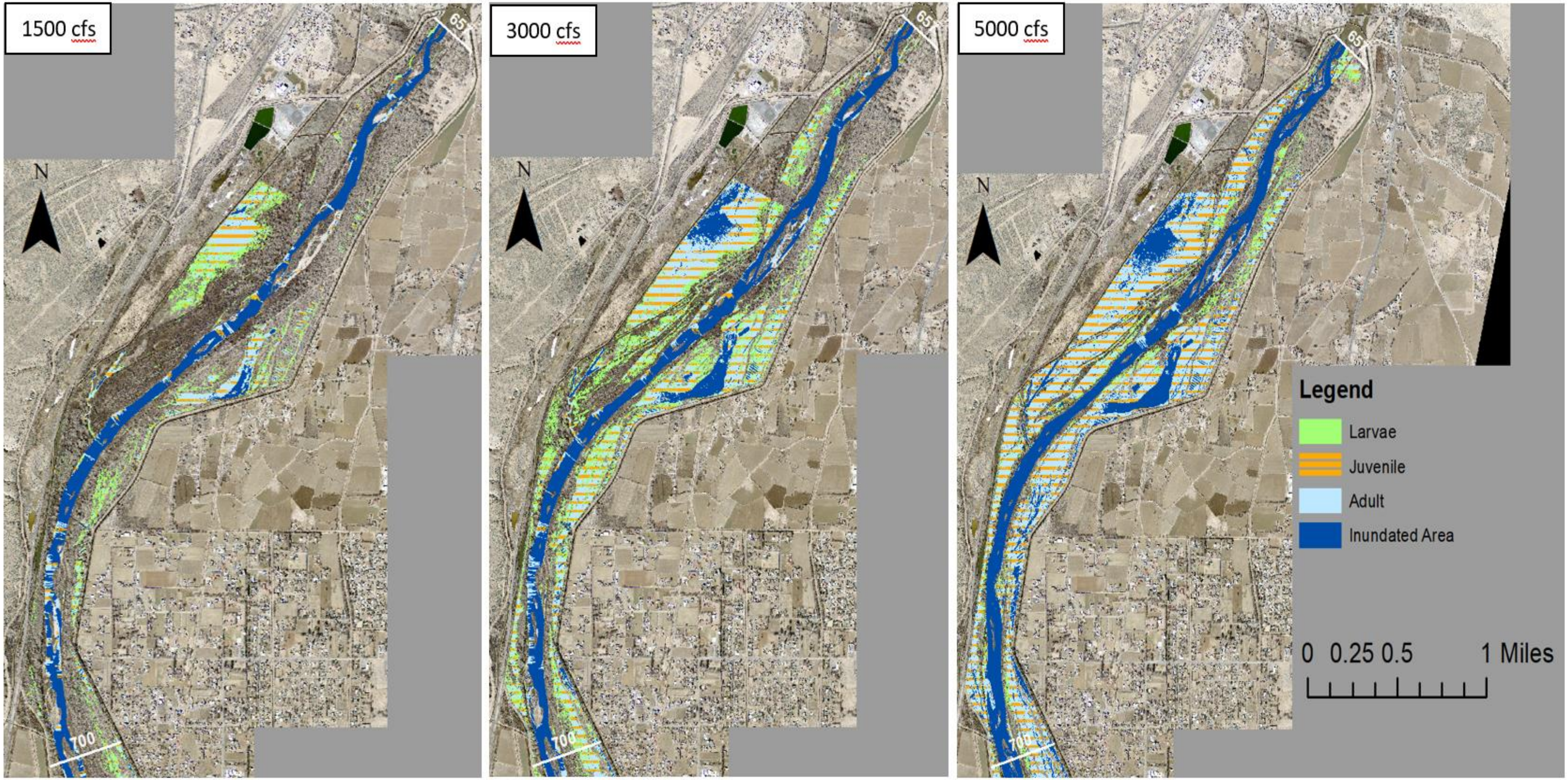
Year	Bankfull Discharge (cfs)
1962	3000
1972	2000
1992	5000
2002	6000
2012	5000

Rio Puerco



Year	Bankfull Discharge (cfs)
1962	8000
1972	4500
1992	6000
2002	6000
2012	4500

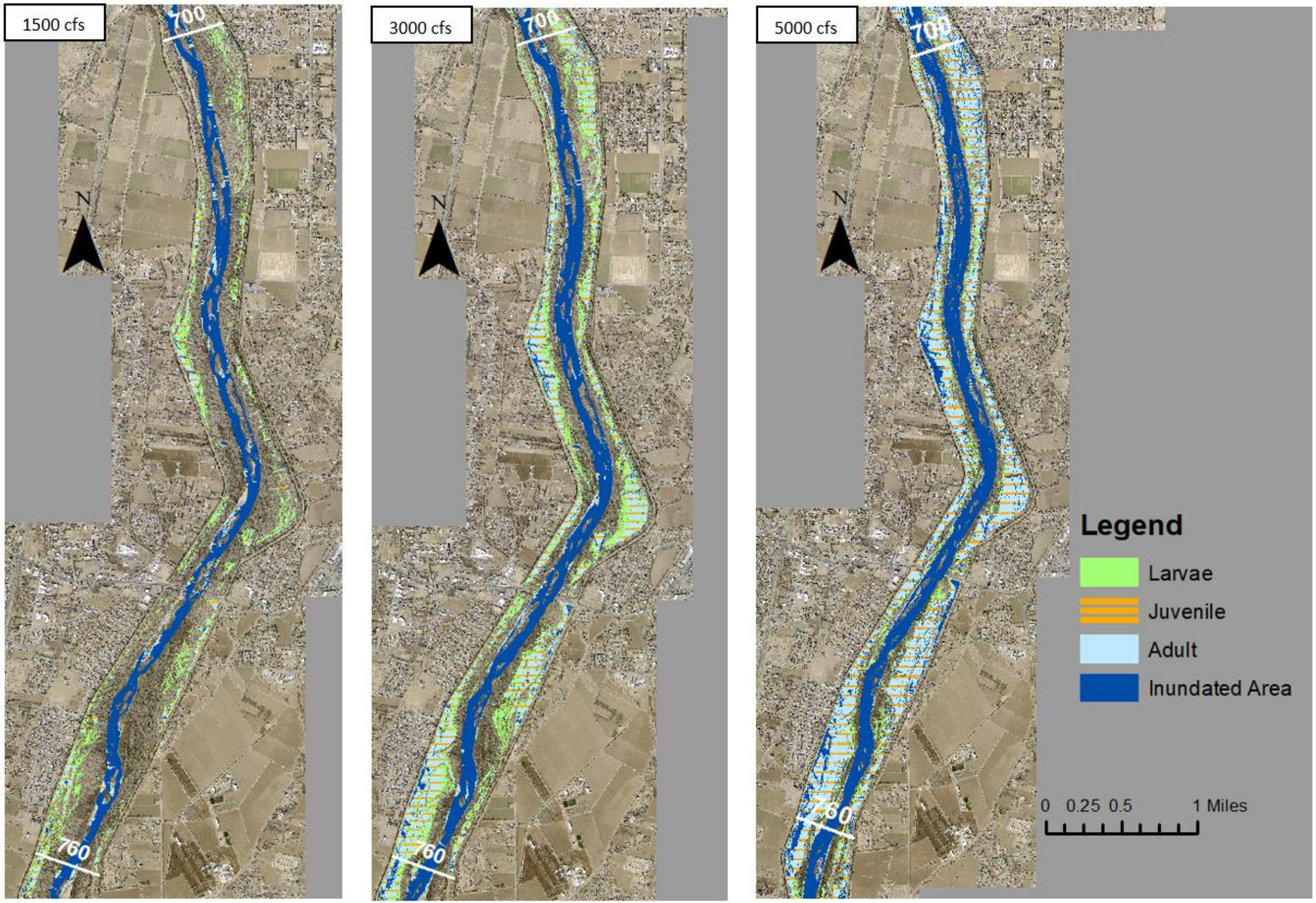
Isleta
Sub-reach I1: agg/deg 657 – 700
Restoration Potential (Low, Medium, High?)



Isleta

Sub-reach I2a:
(agg/deg 700-760)

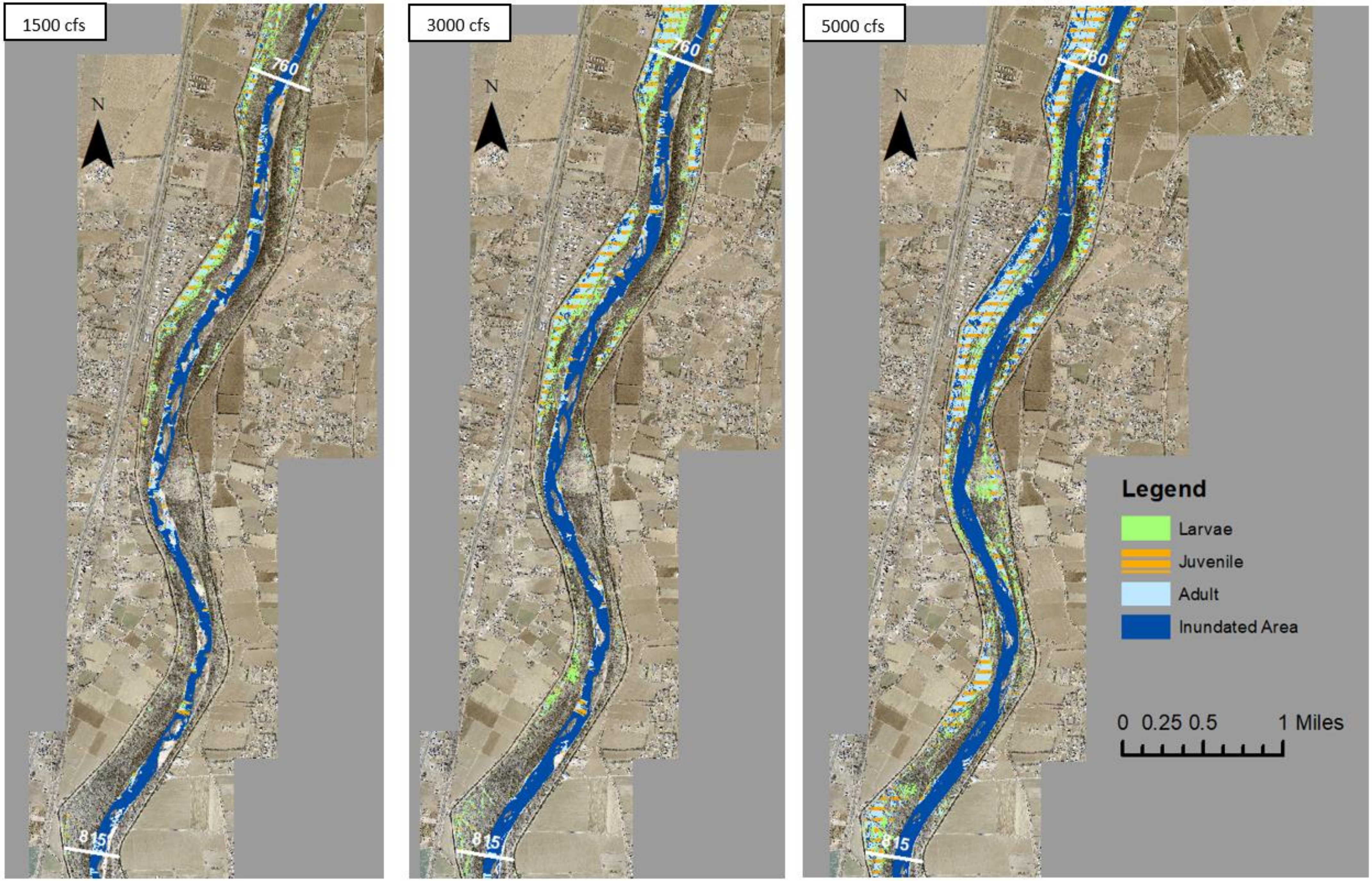
Restoration Potential (Low, Medium, High?)



Isleta

Sub-reach I2b: (agg/deg 760-815)

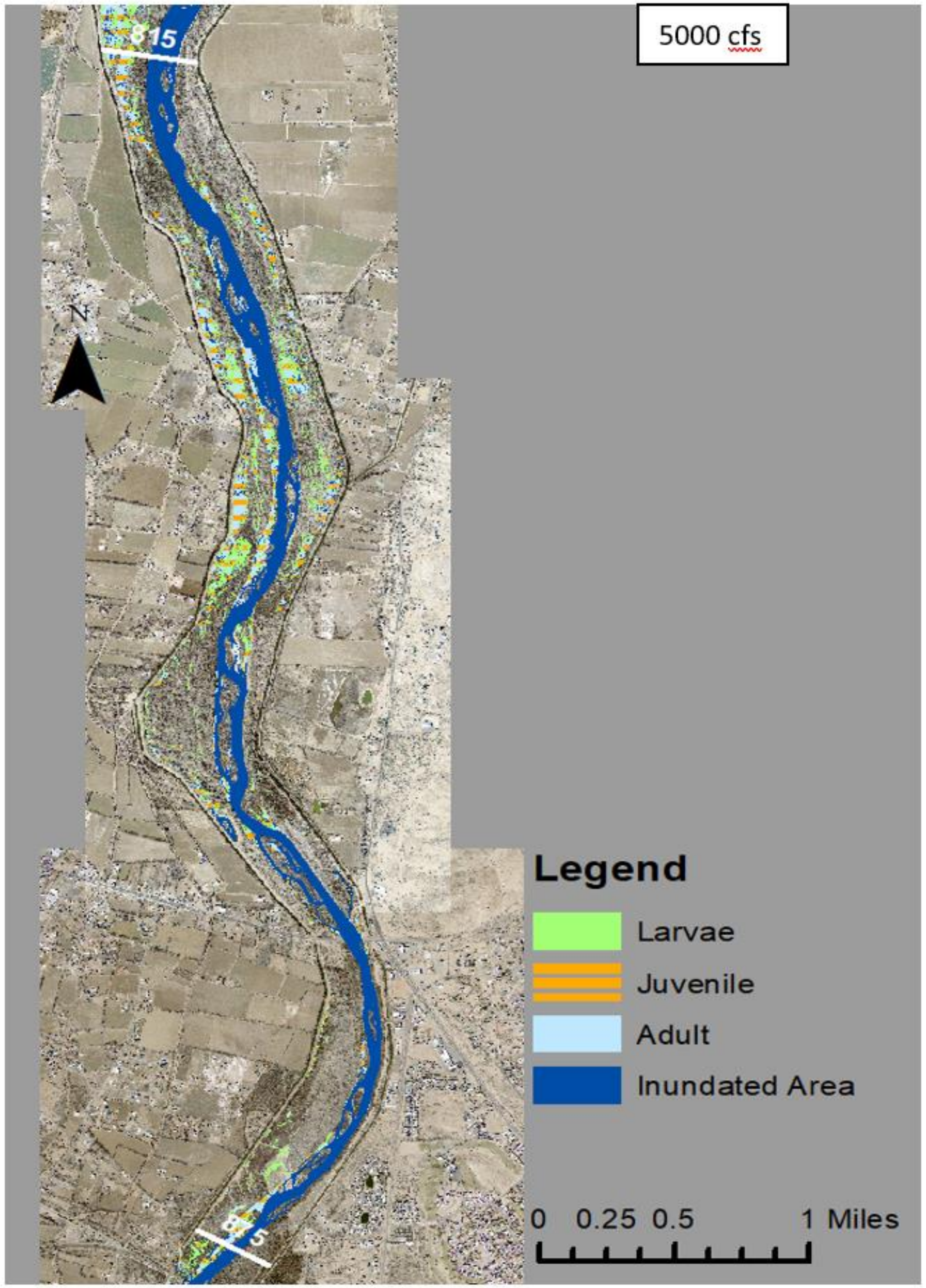
Restoration Potential (Low, Medium, High?)



Isleta

Sub-reach I3a: (agg/deg 815-875)

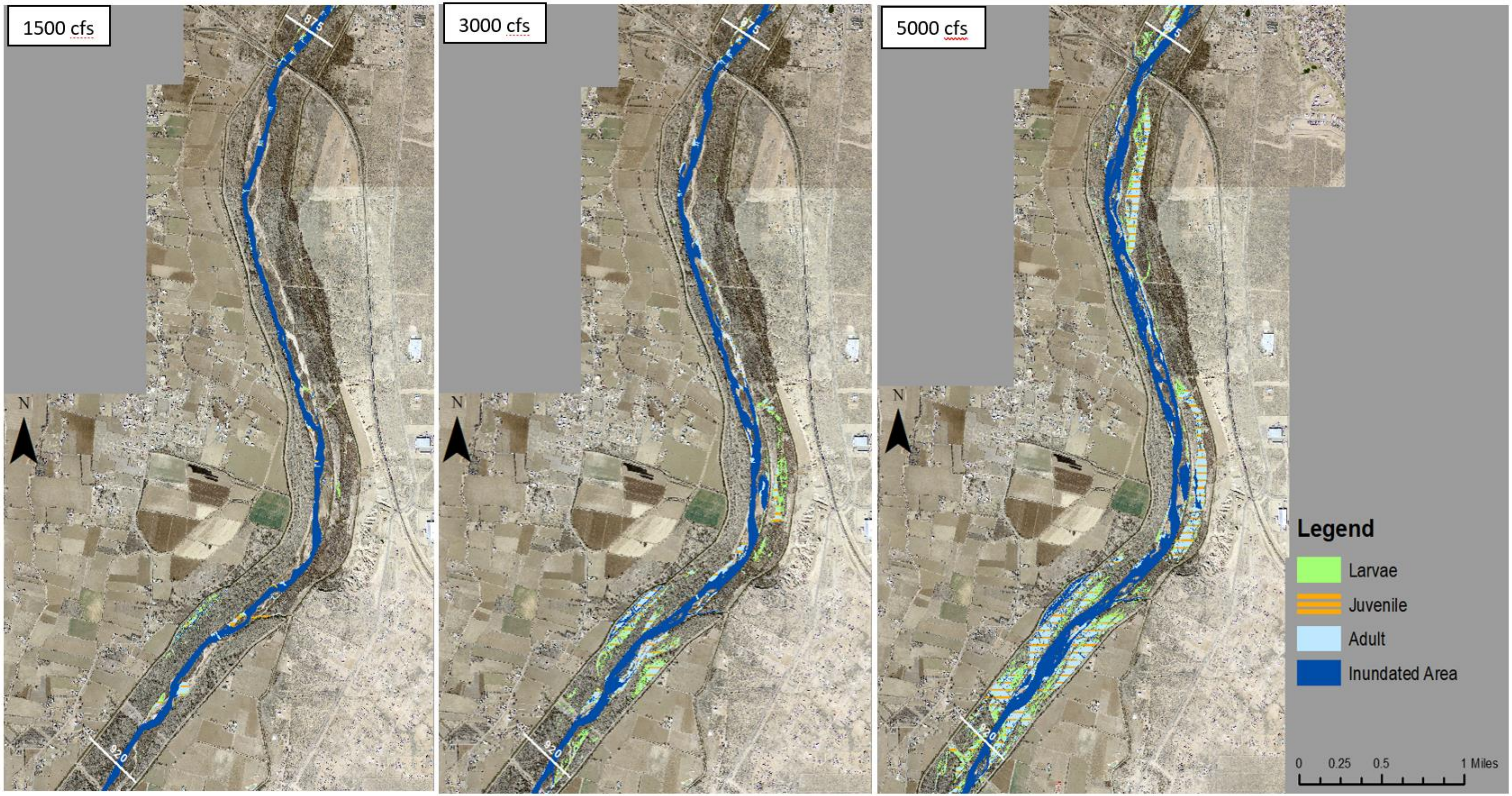
Restoration Potential (Low, Medium, High?)



Isleta

Sub-reach I3b: agg/deg 875 – 920

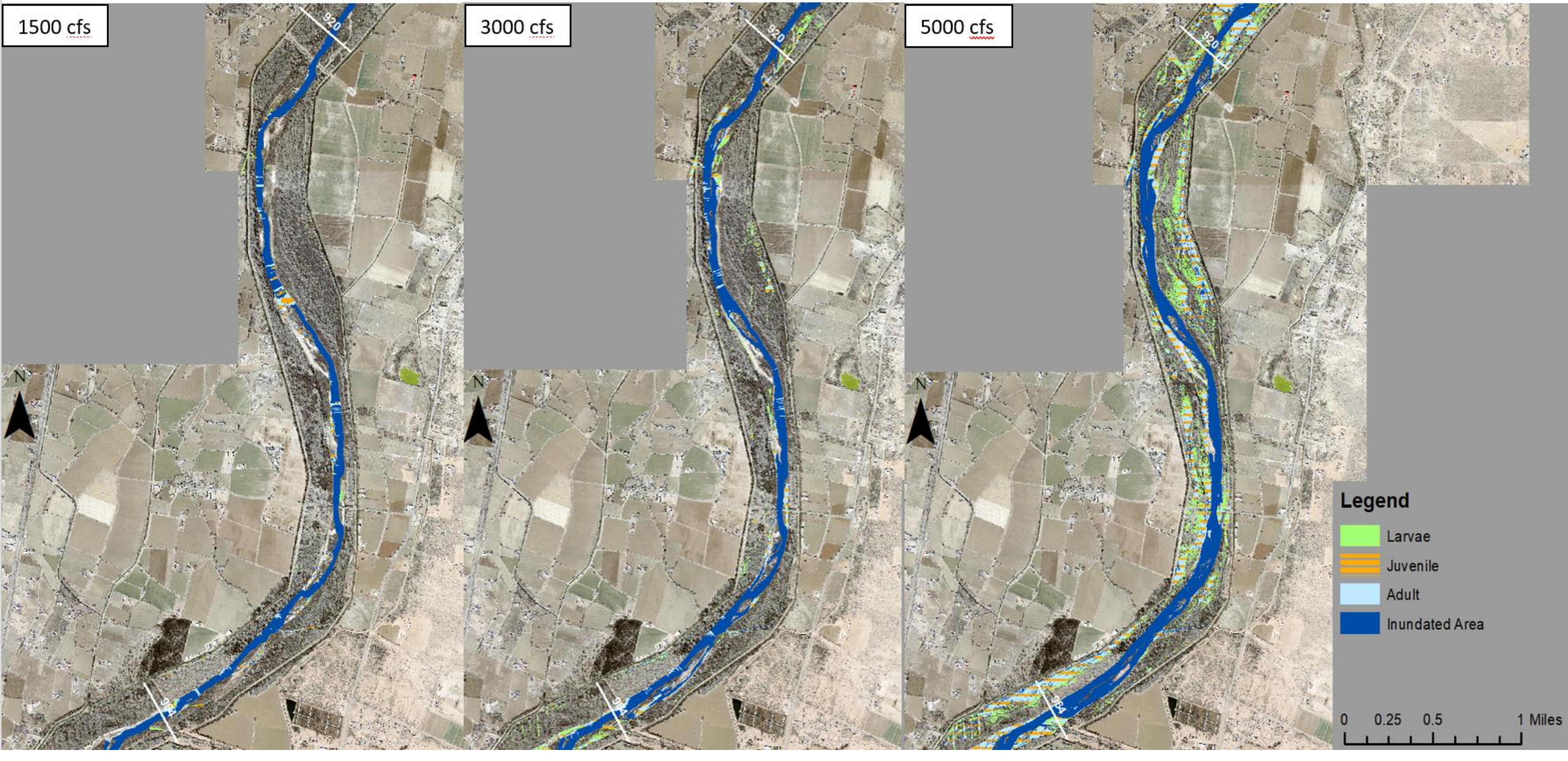
Restoration Potential (Low, Medium, High?)



Isleta

Sub-reach I3c: agg/deg 920 – 964

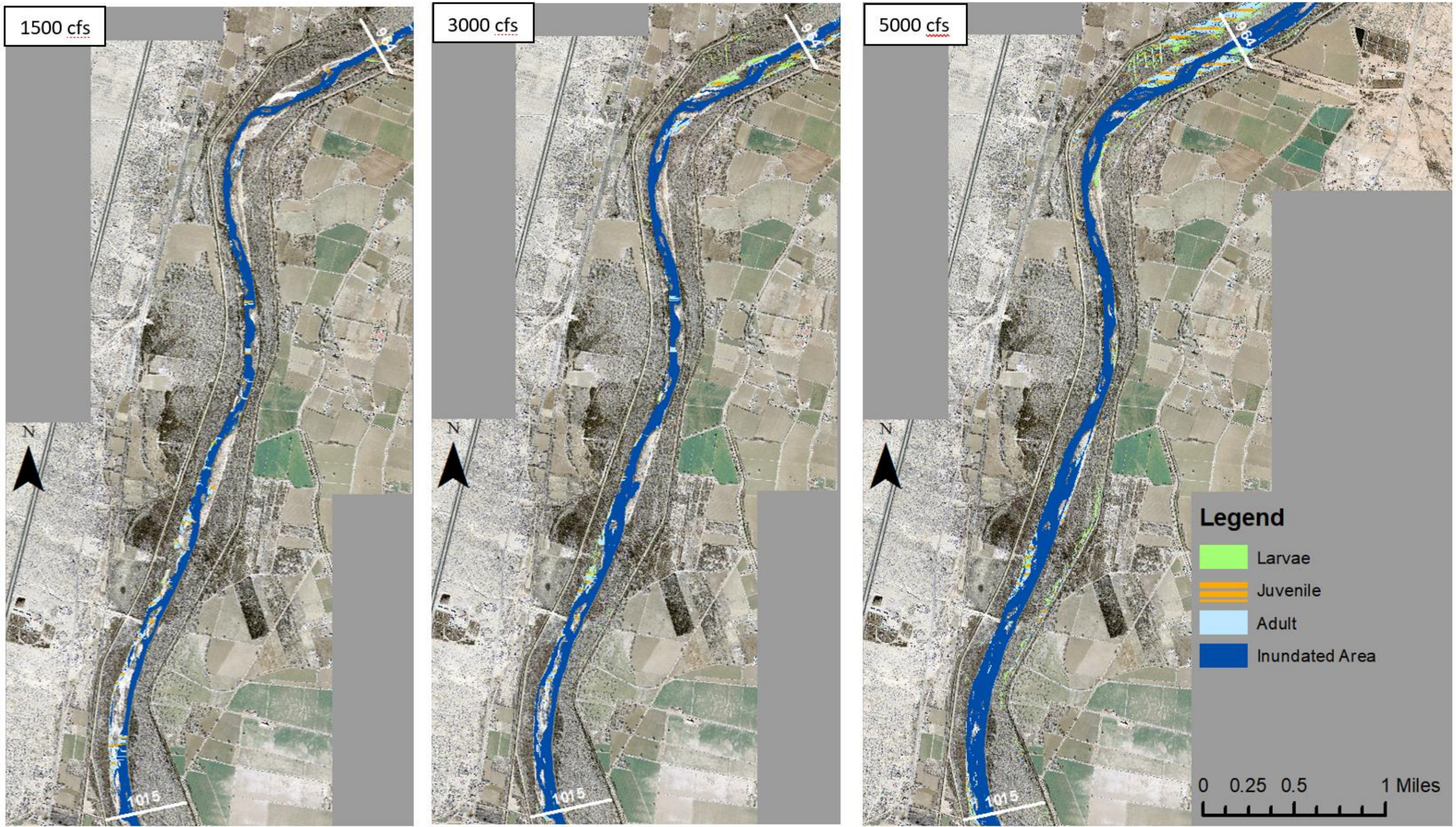
Restoration Potential (Low, Medium, High?)



Isleta

Sub-reach I4: agg/deg 964 – 1015

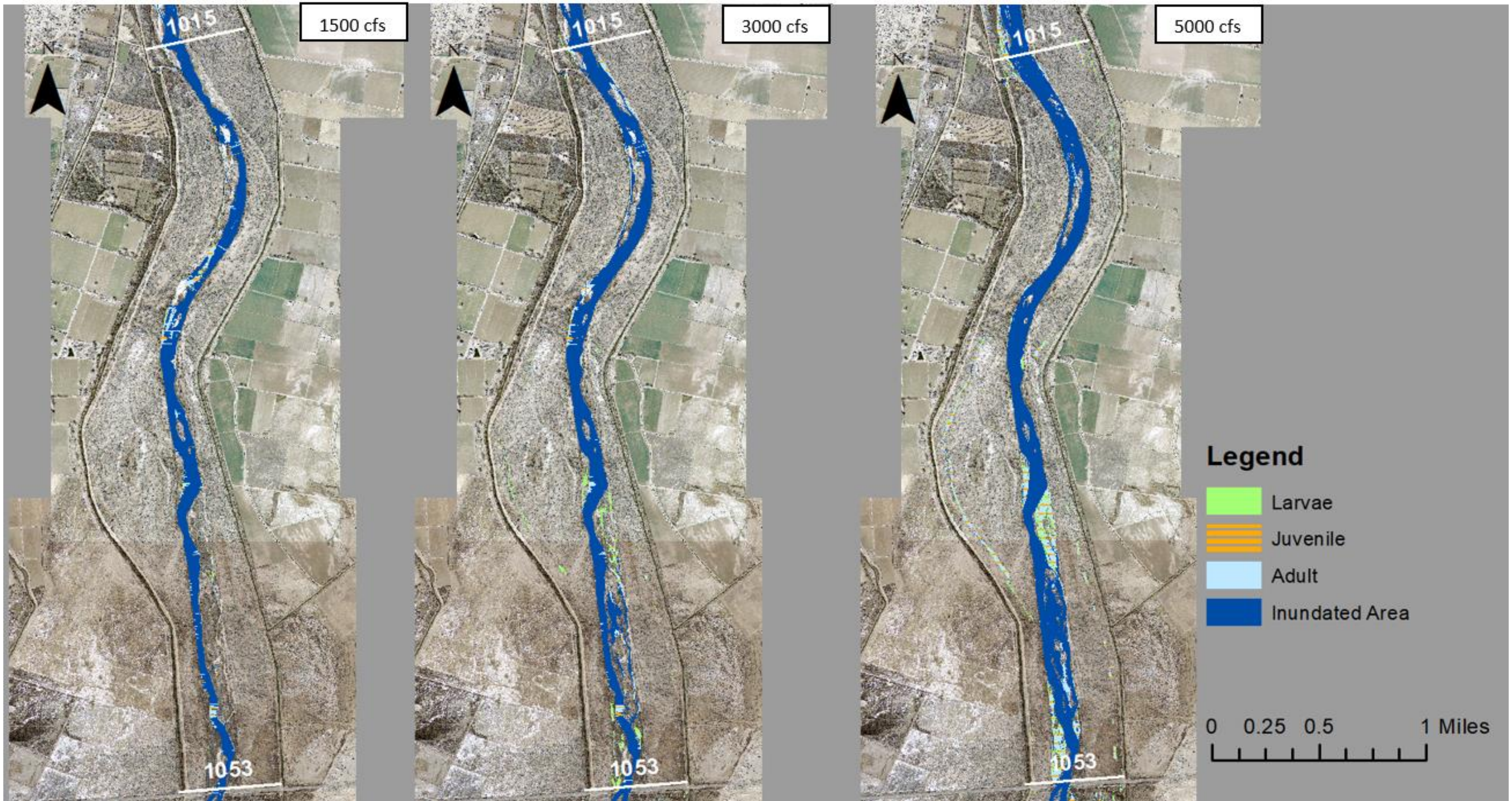
Restoration Potential (Low, Medium, High?)



Isleta

Subreach I5: (agg/deg 1015 - 1053)

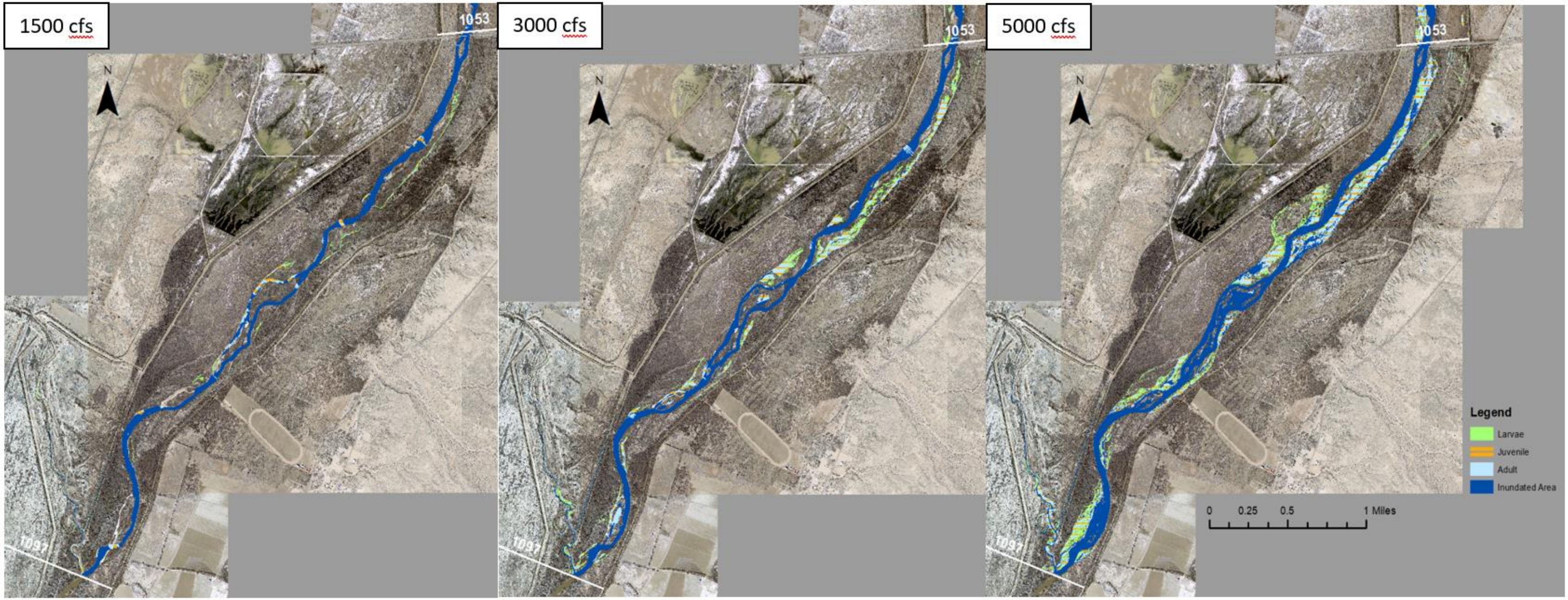
Restoration Potential (Low, Medium, High?)



Isleta

Sub-reach I6: (agg/deg 1053 - 1097)

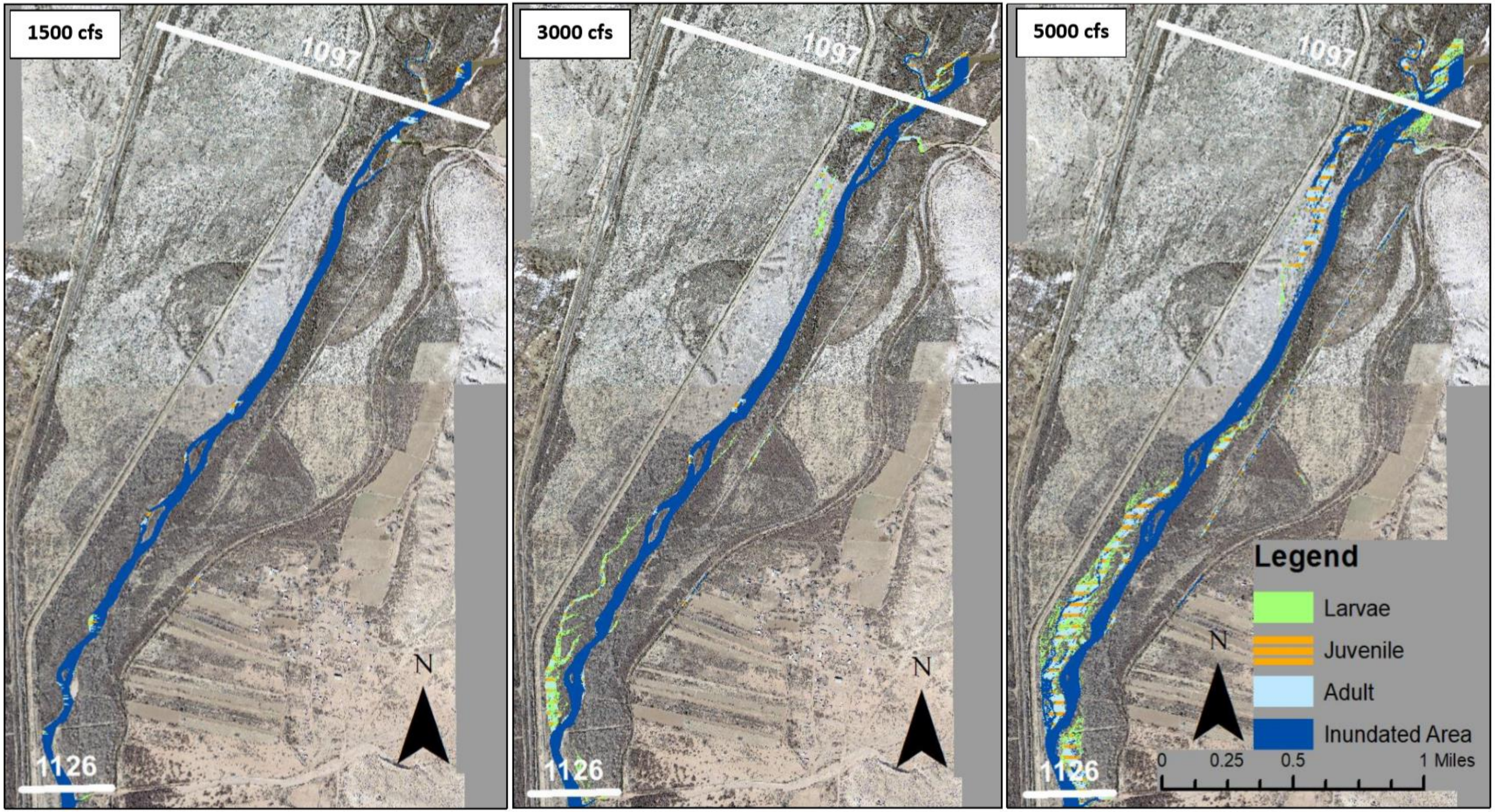
Restoration Potential (Low, Medium, High?)



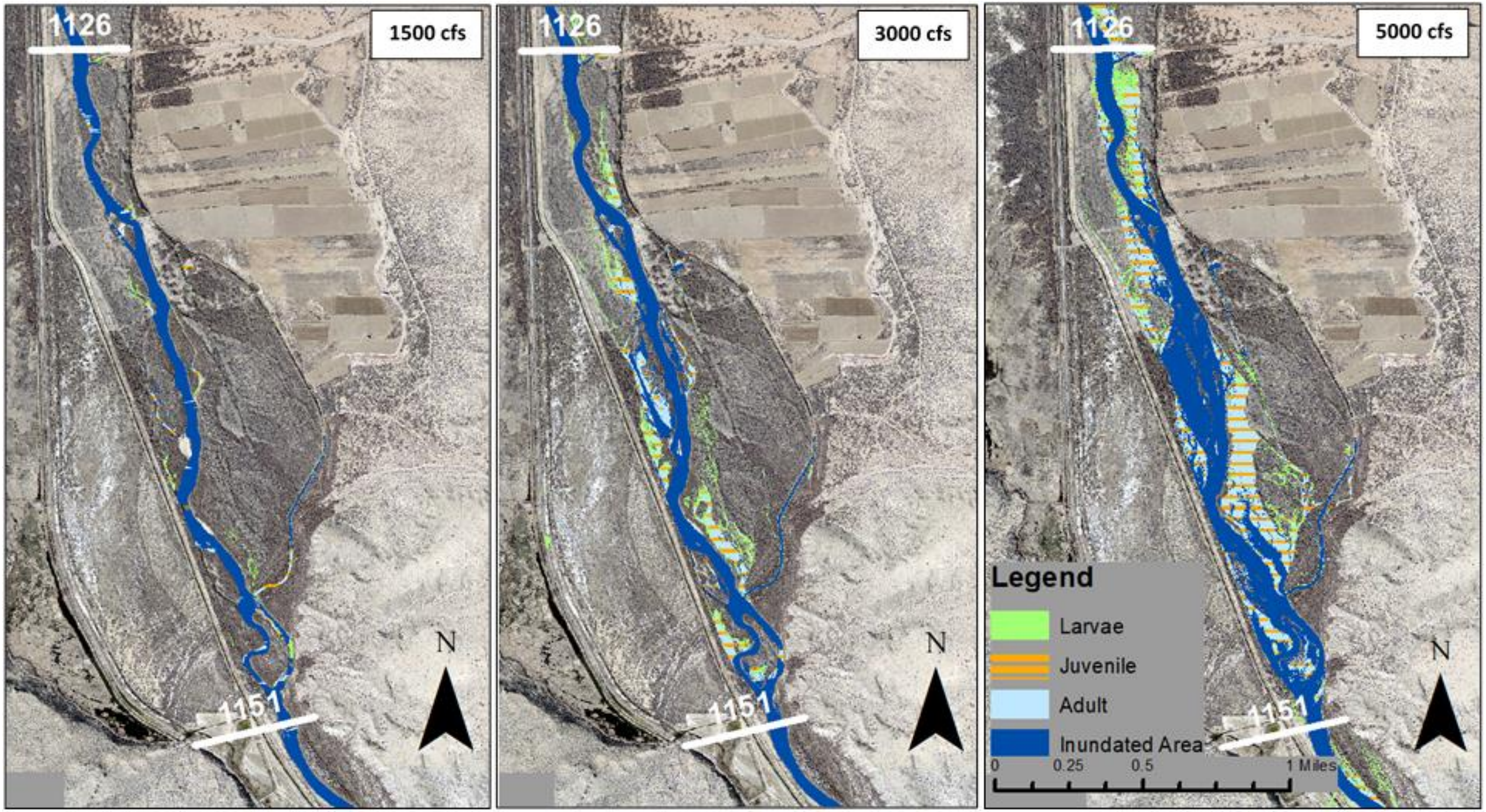
Rio Puerco

Sub-reach P1: (agg/deg 1097-1126)

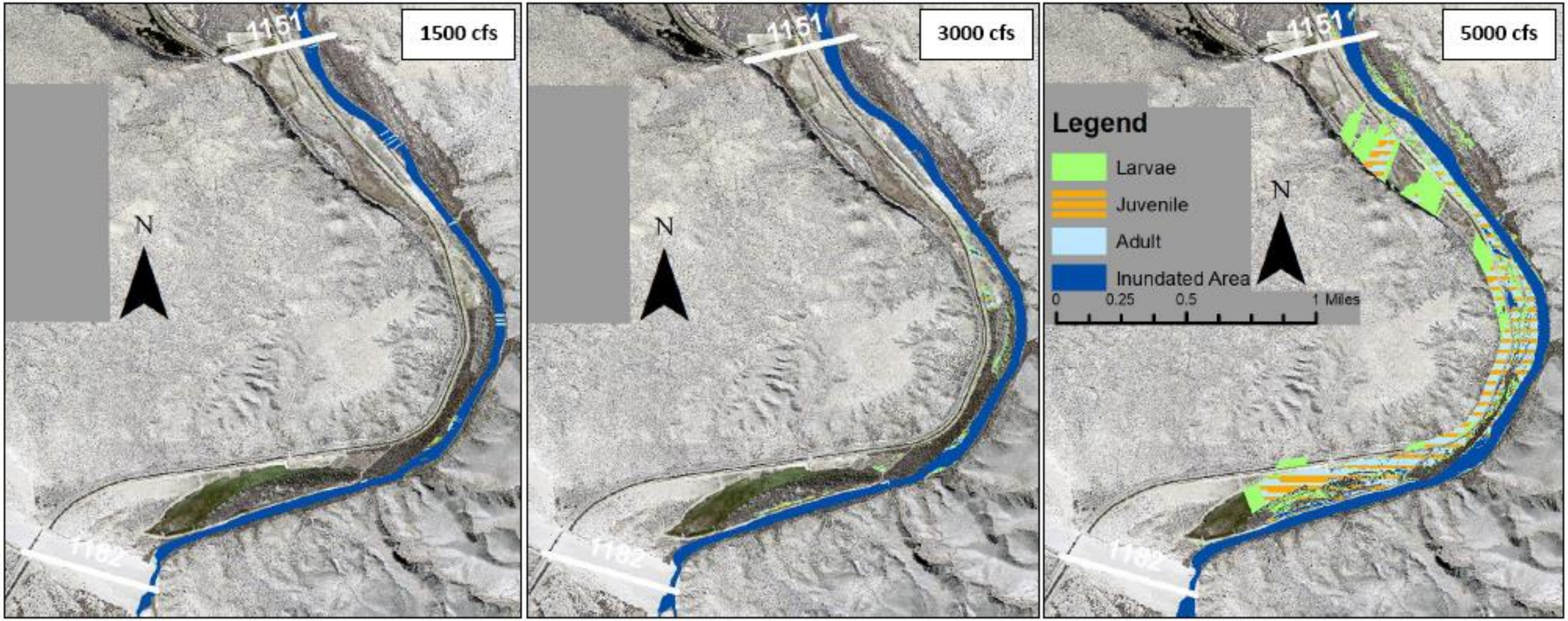
Restoration Potential (Low, Medium, High?)



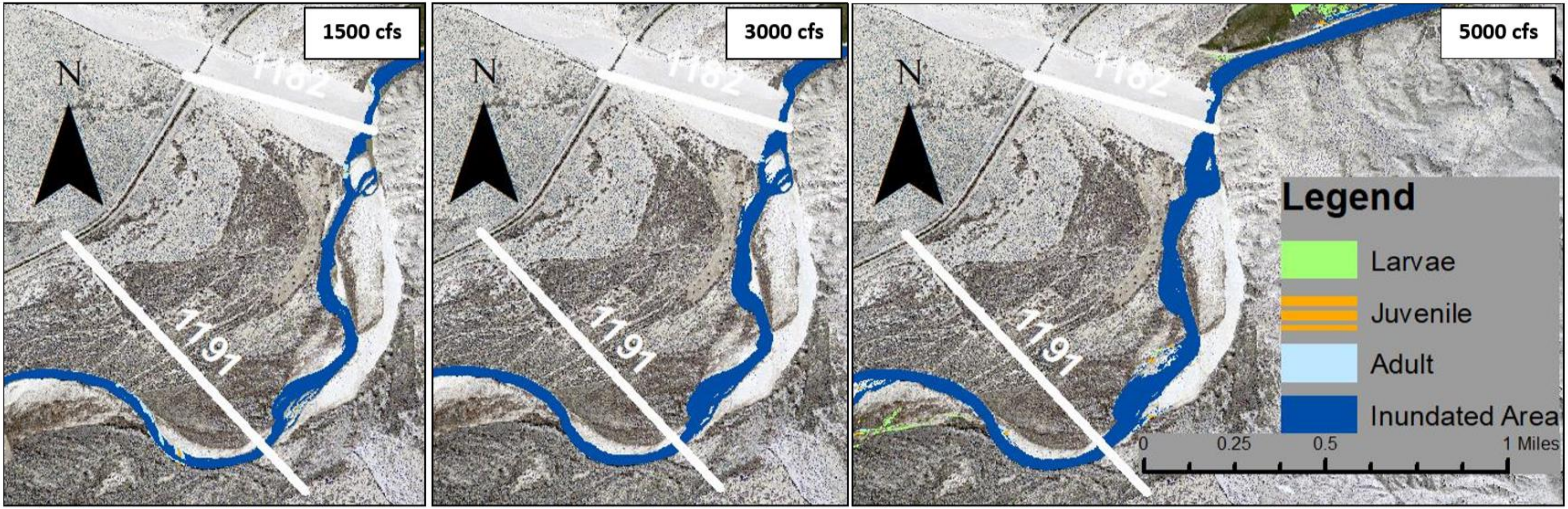
Rio Puerco
Sub-reach P2: (agg/deg 1126 - 1151)
Restoration Potential (Low, Medium, High?)



Rio Puerco
Sub-reach P3: (agg/deg 1151-1182)
Restoration Potential (Low, Medium, High?)



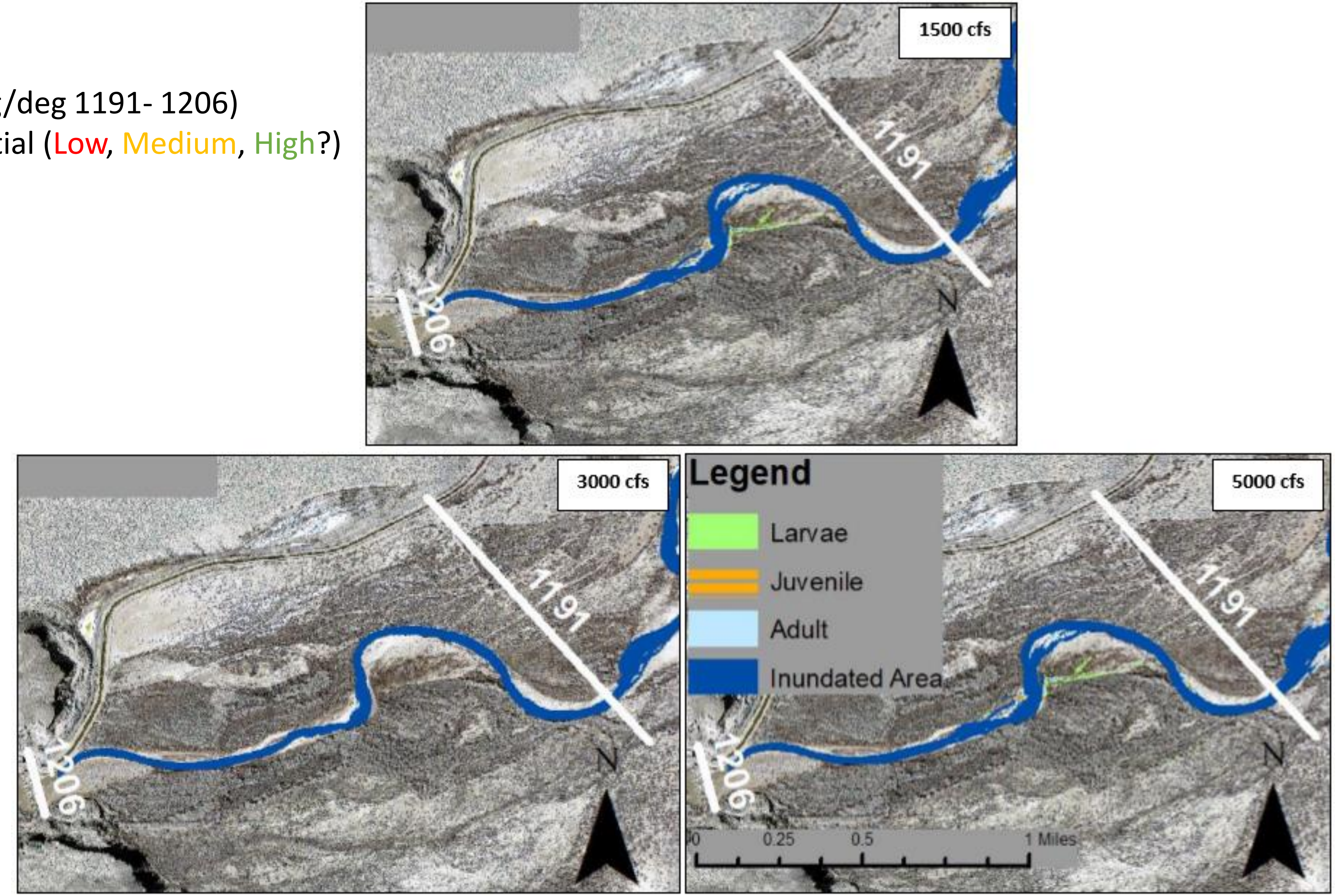
Rio Puerco
Sub-reach P4: (agg/deg 1182-1191)
Restoration Potential (Low, Medium, High?)



Rio Puerco

Sub-reach P5: (agg/deg 1191- 1206)

Restoration Potential (Low, Medium, High?)



Restoration Potential Assessment

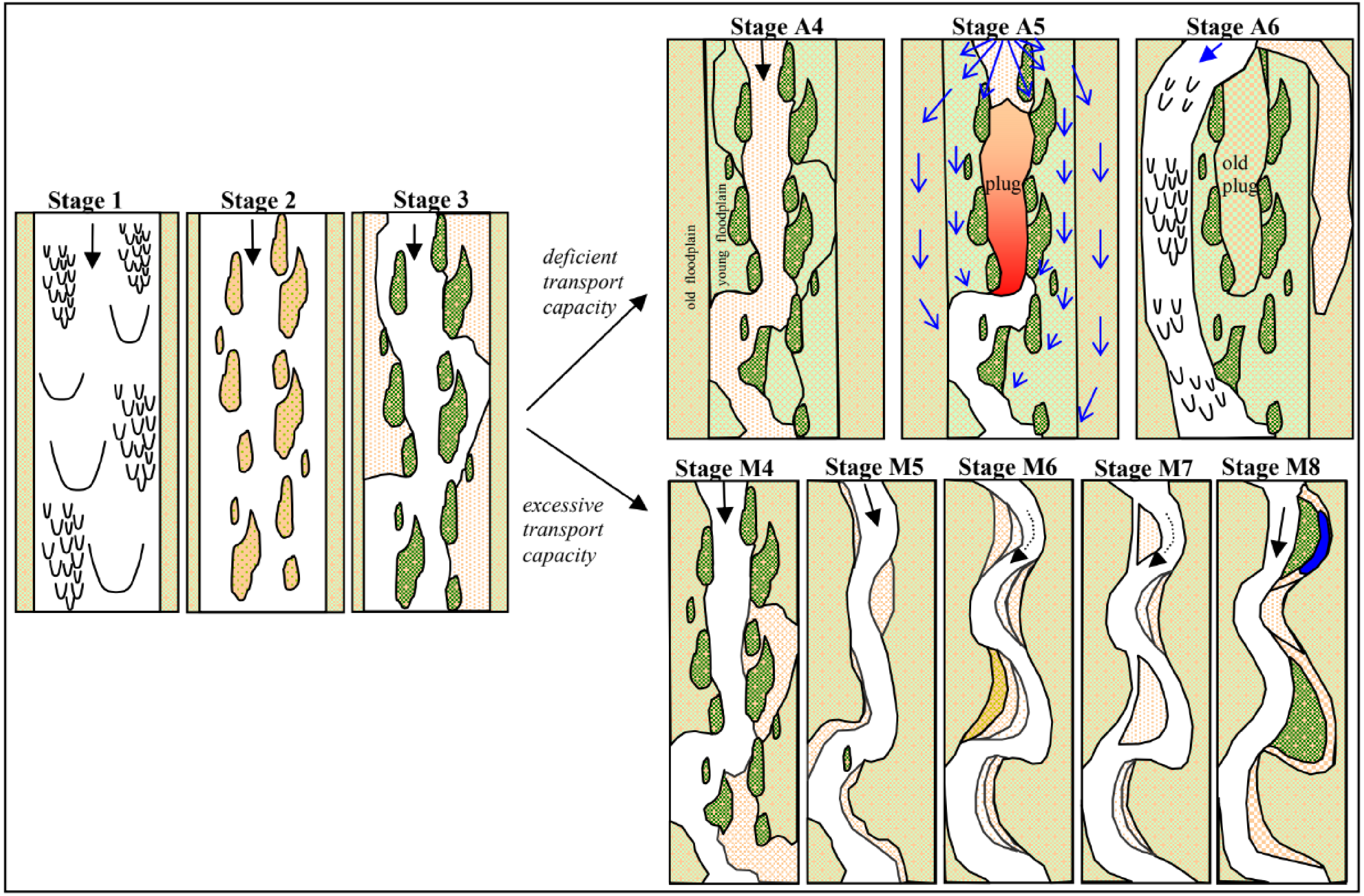
Sub-reach	CSU's Prelim. Assessment	UNM/ASIR's Assessment!!!
I1	High	
I2	Medium-High	
I3	Medium	
I4	Low	
I5	Low	
I6	Medium	
P1	Medium	
P2	Medium-High	
P3	Low-Medium	
P4	Low	
P5	Low	

Contents

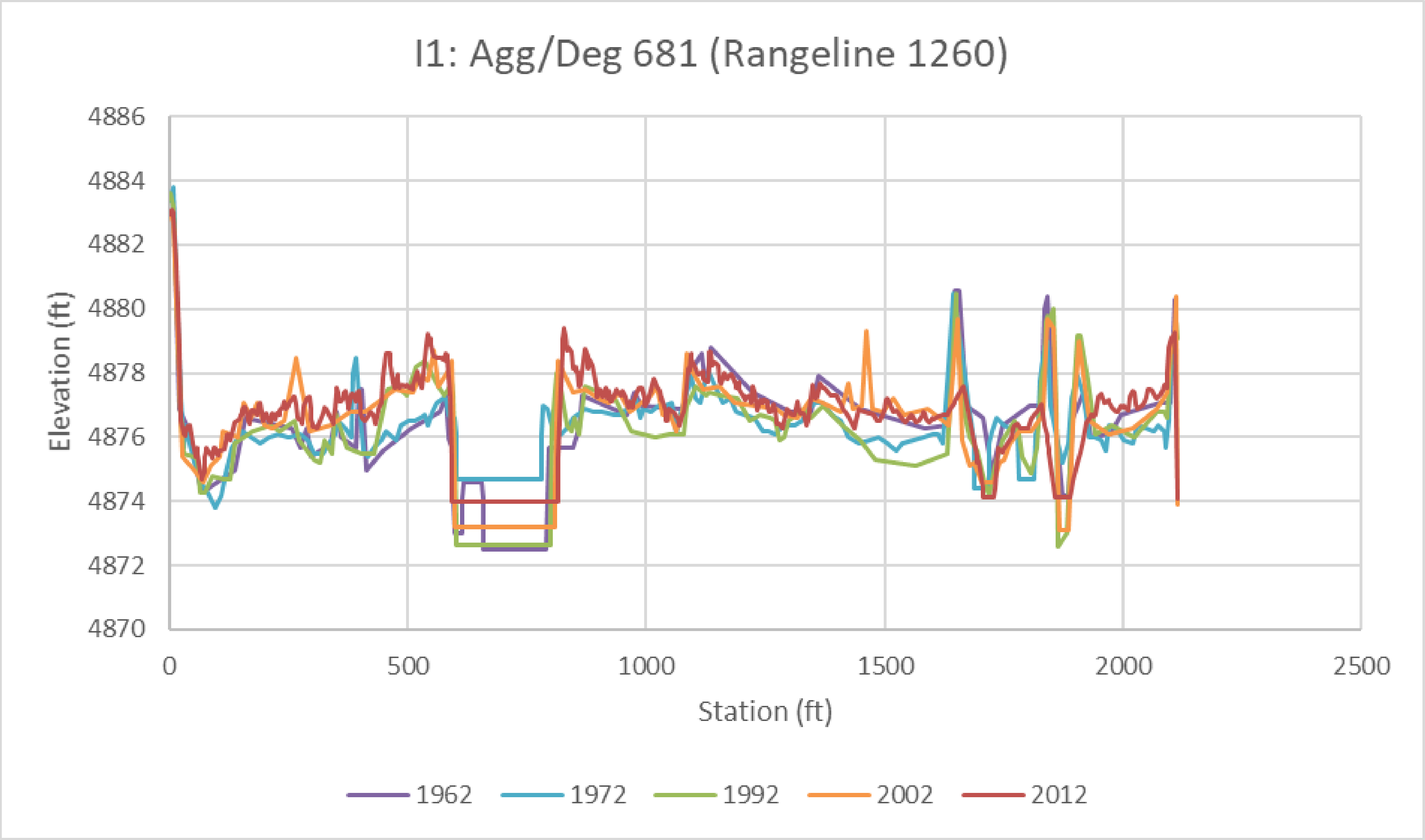
Massong's Model

A = Aggrading

M = Migrating

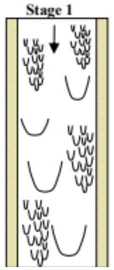


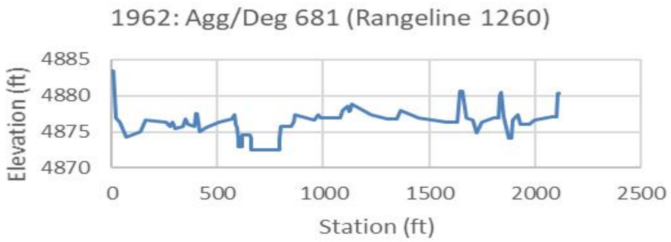
Isleta

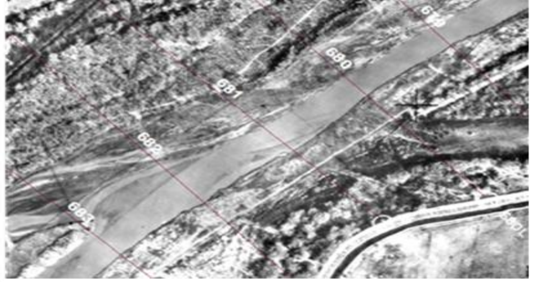


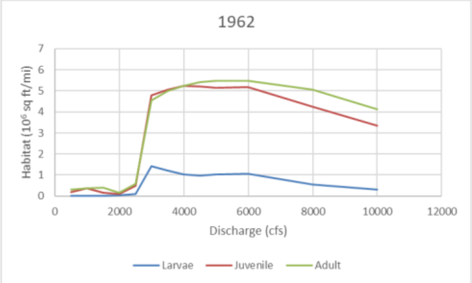
I1: Agg/Deg 681 (Rangeline 1260)
Elevation (ft)
4886
4884
4882
4880
4878
4876
4874
4872
4870
0
500
1000
1500
2000
2500
Station (ft)
1962
1972
1992
2002
2012

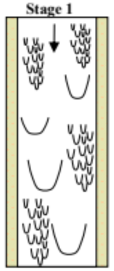
Isleta Sub-reach I1

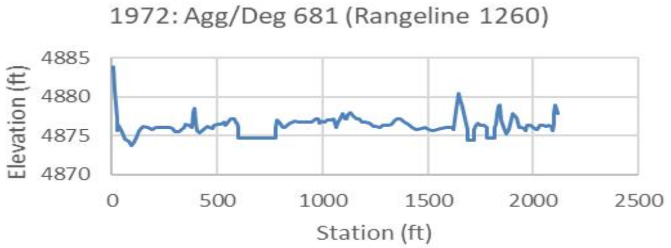


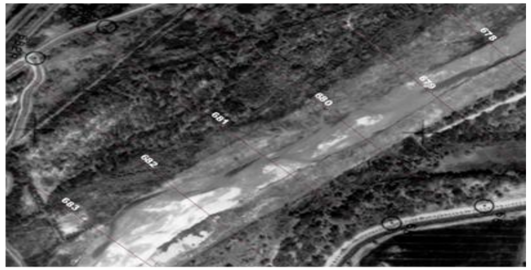


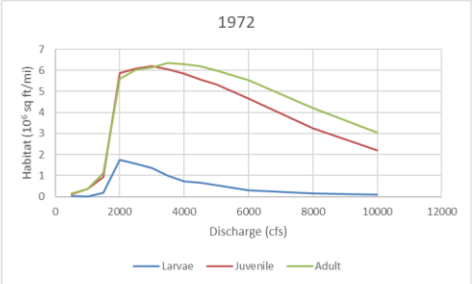


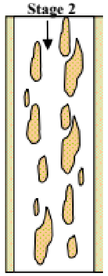


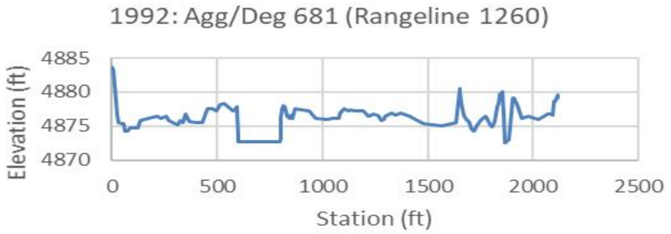


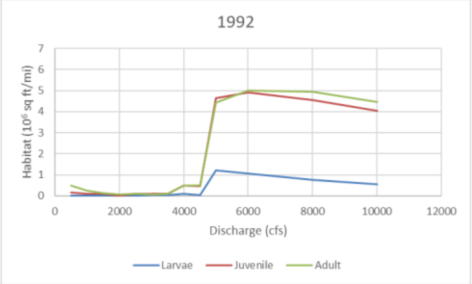


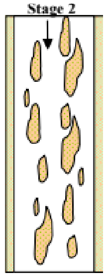


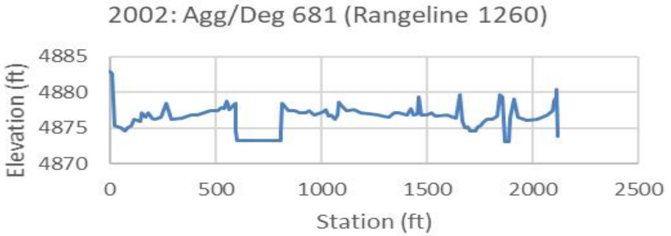


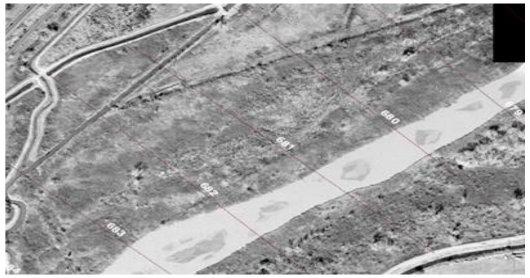


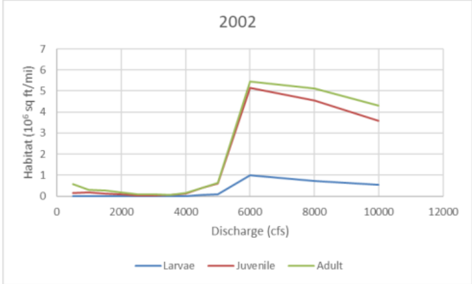


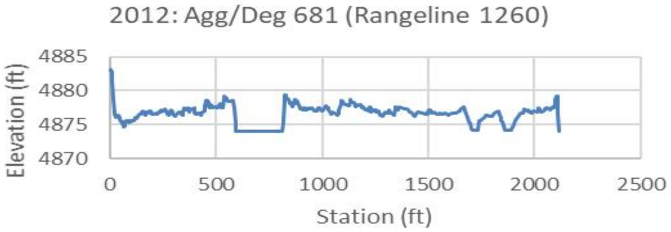


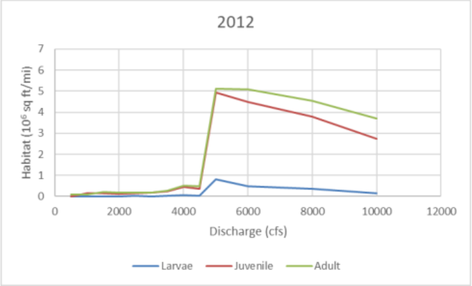


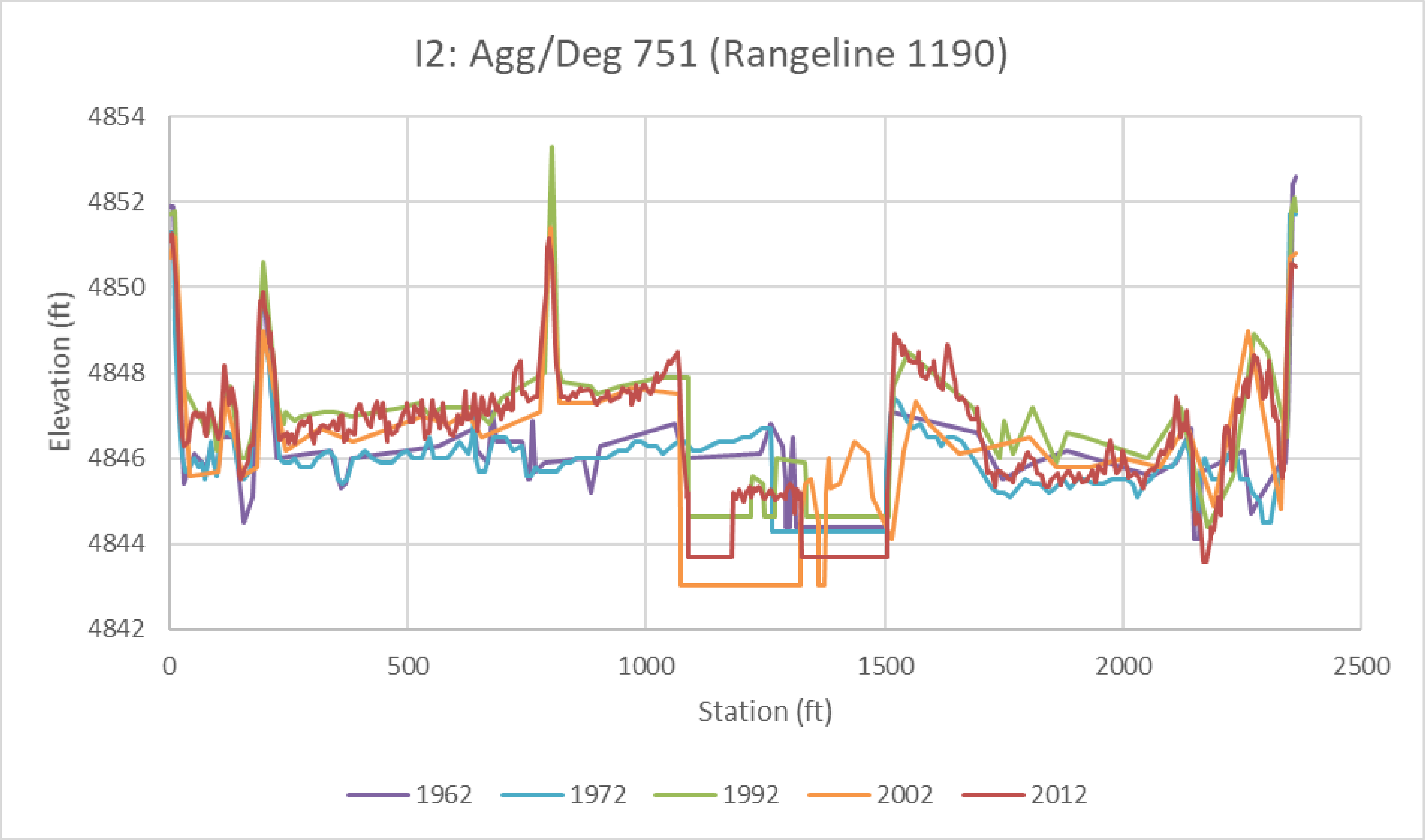






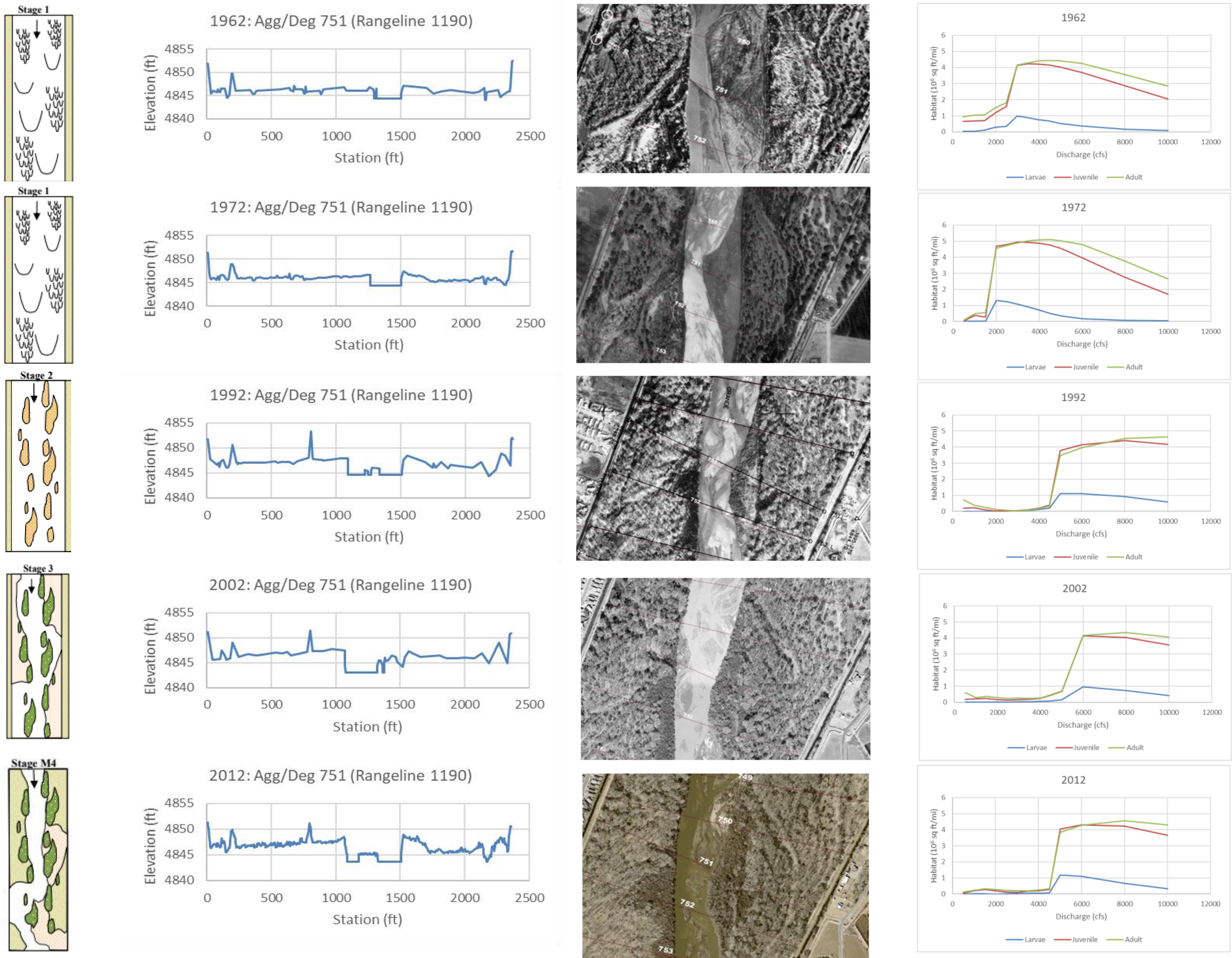


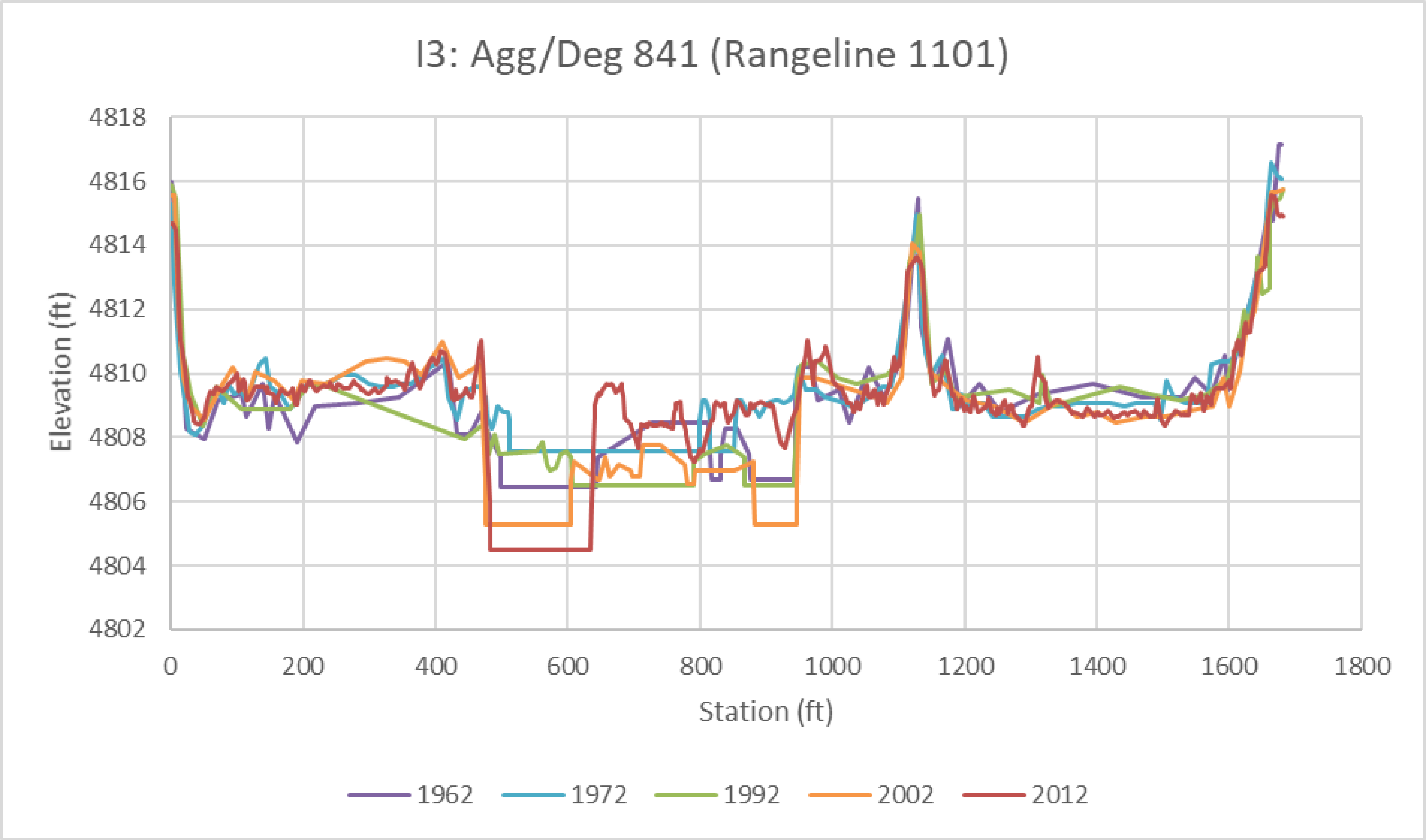




I2: Agg/Deg 751 (Rangeline 1190)
4854
4852
4850
4848
4846
4844
4842
Elevation (ft)
0
500
1000
1500
2000
2500
Station (ft)
1962
1972
1992
2002
2012

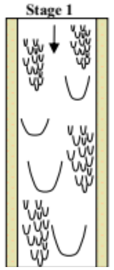
Isleta
Sub-reach I2

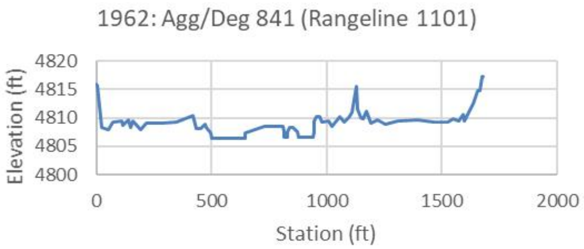


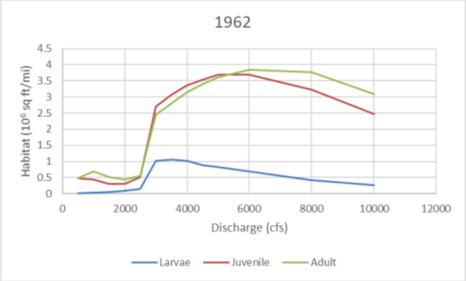


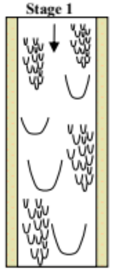
I3: Agg/Deg 841 (Rangeline 1101)
4818
4816
4814
4812
4810
4808
4806
4804
4802
Elevation (ft)
0
200
400
600
800
1000
1200
1400
1600
1800
Station (ft)
1962
1972
1992
2002
2012

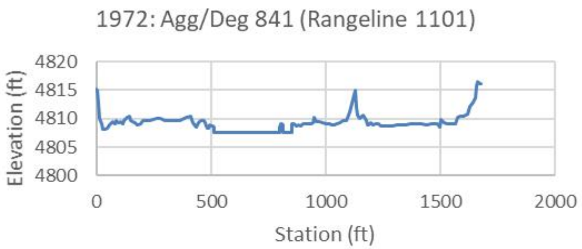
Isleta
Sub-reach I3

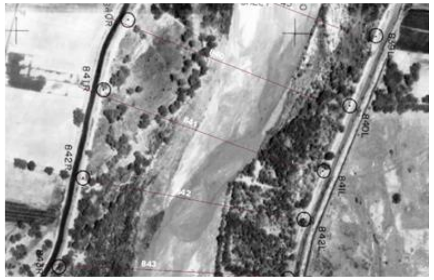


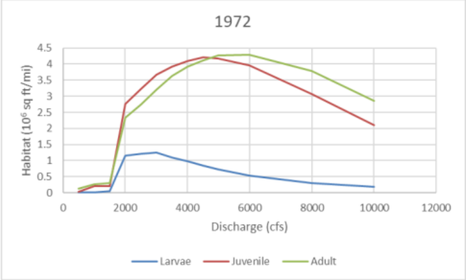


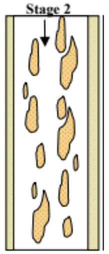


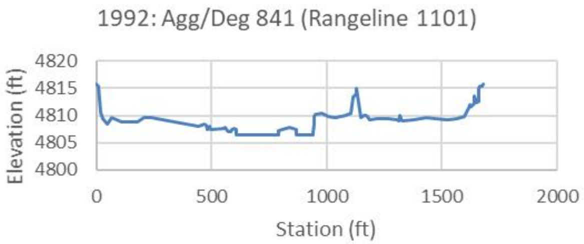


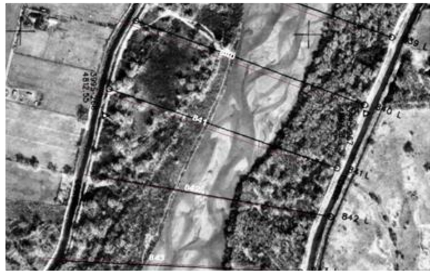


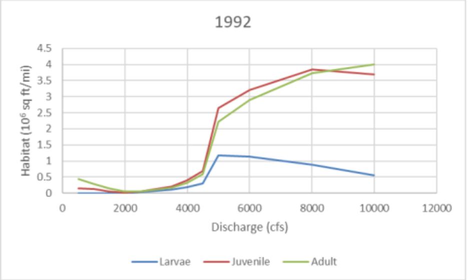


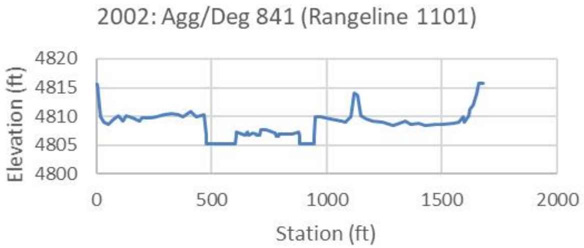


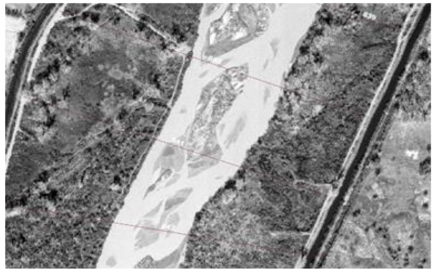


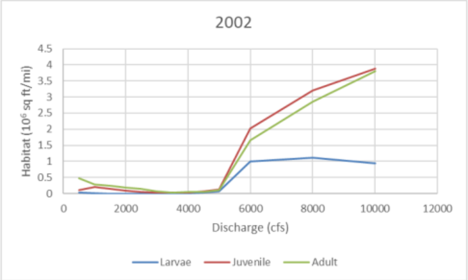


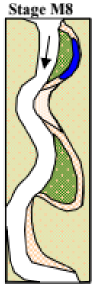


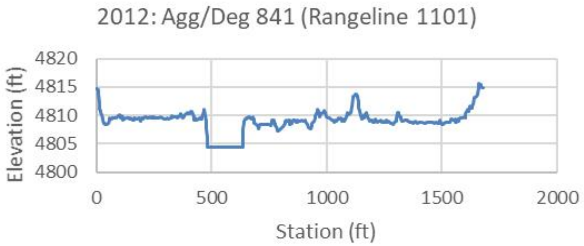


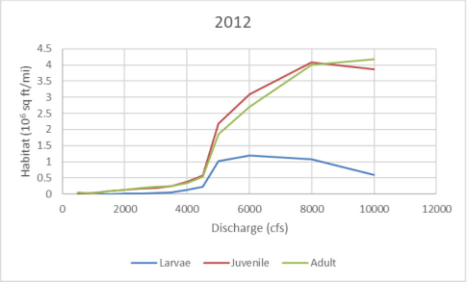


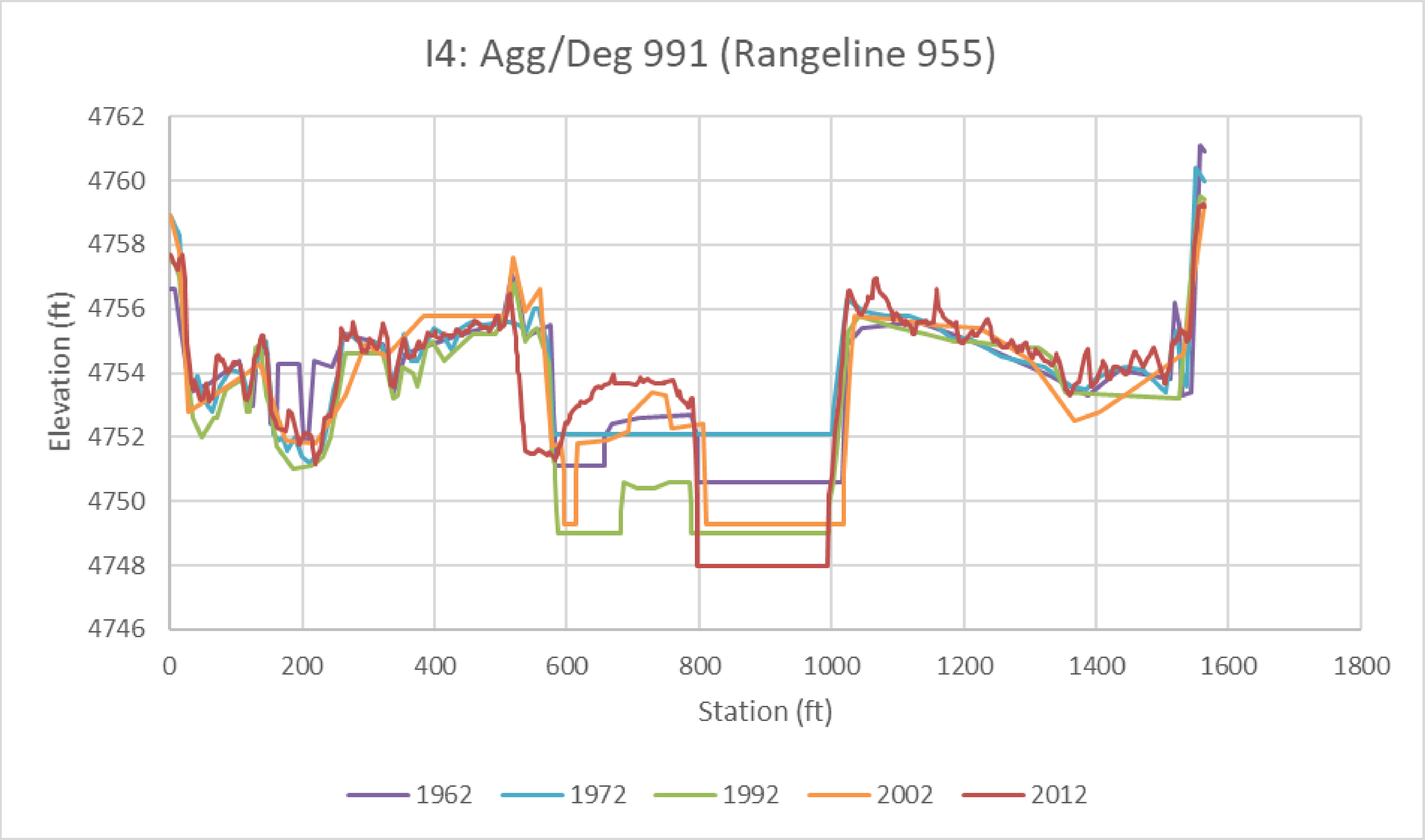




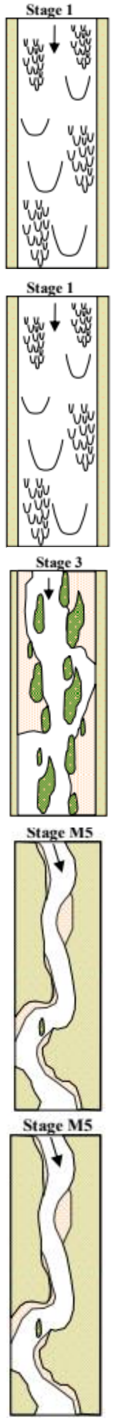


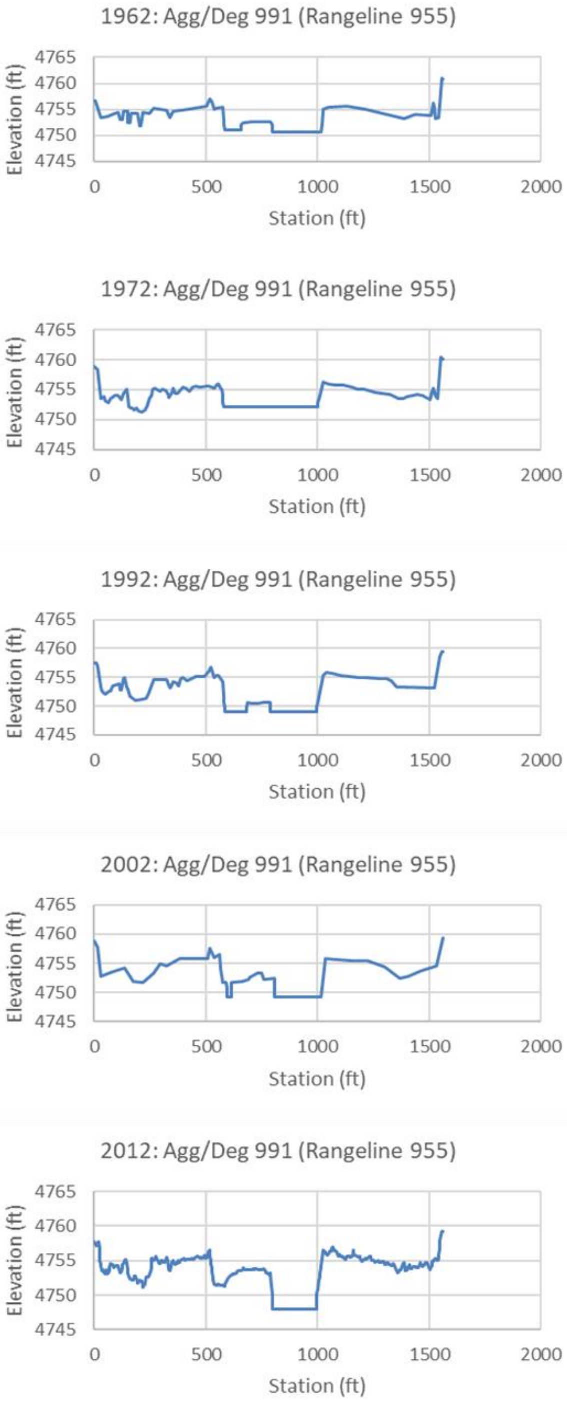


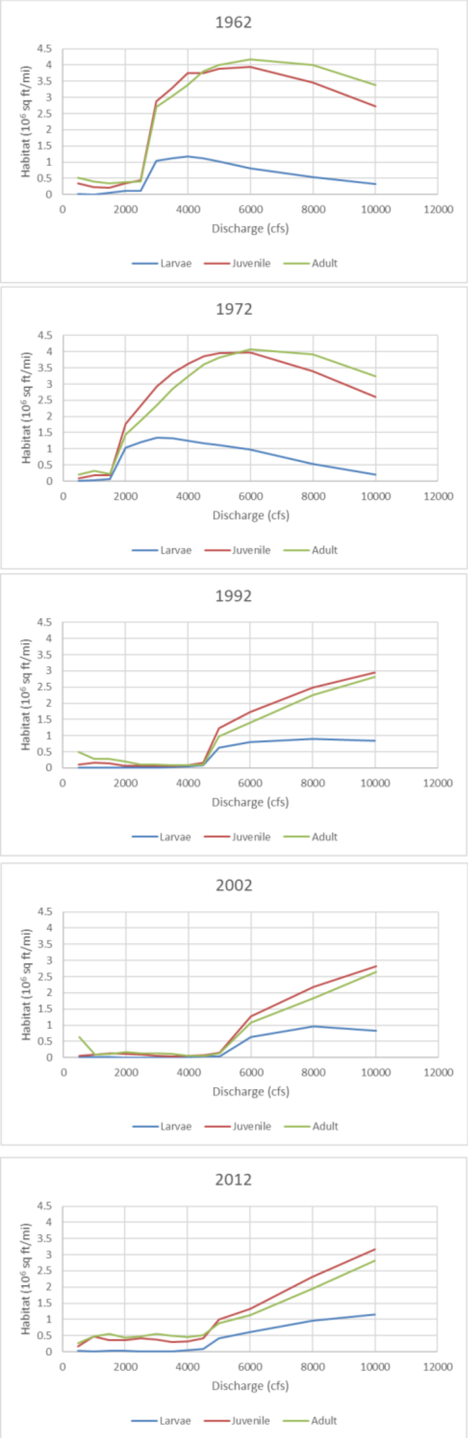


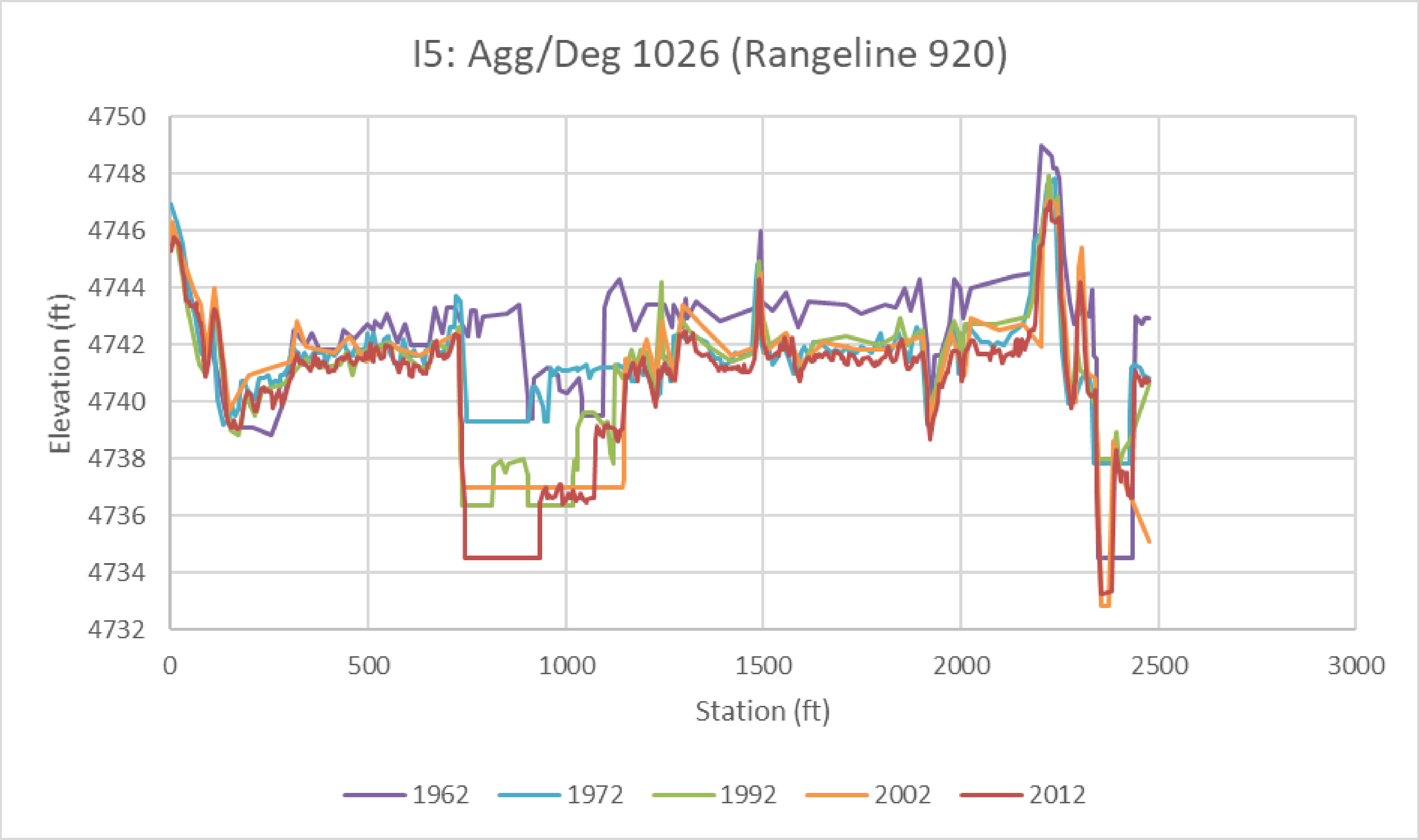

I4: Agg/Deg 991 (Rangeline 955)
Elevation (ft)
4762
4760
4758
4756
4754
4752
4750
4748
4746
0
200
400
600
800
1000
1200
1400
1600
1800
Station (ft)
1962
1972
1992
2002
2012

Isleta
Sub-reach I4

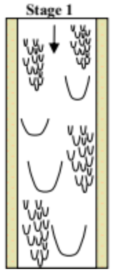


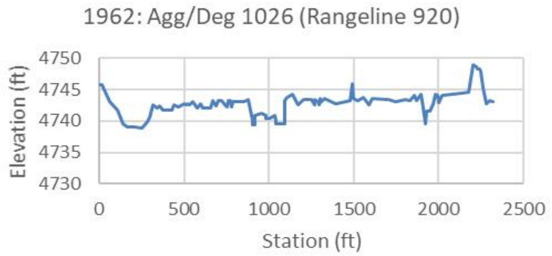


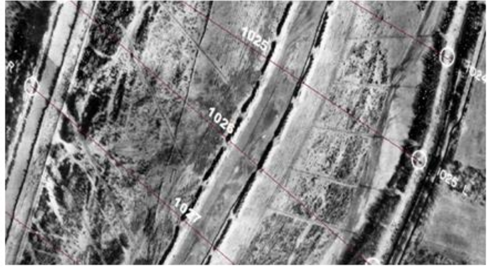


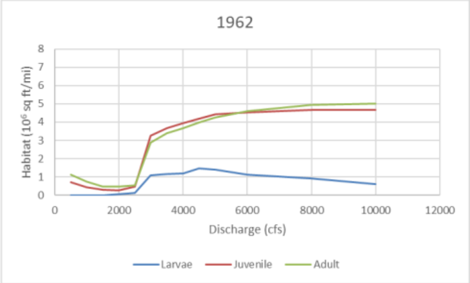

I5: Agg/Deg 1026 (Rangeline 920)
Elevation (ft)
4750
4748
4746
4744
4742
4740
4738
4736
4734
4732
0
500
1000
1500
2000
2500
3000
Station (ft)
1962
1972
1992
2002
2012

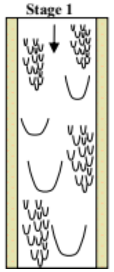
Isleta
Sub-reach I5

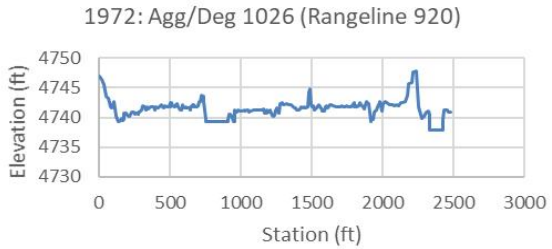


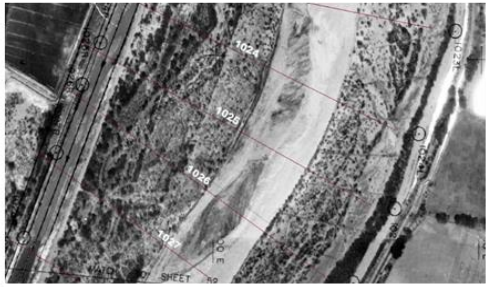


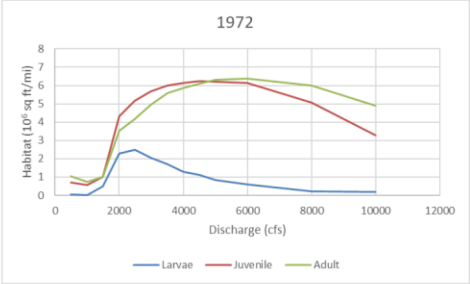


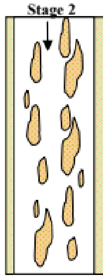


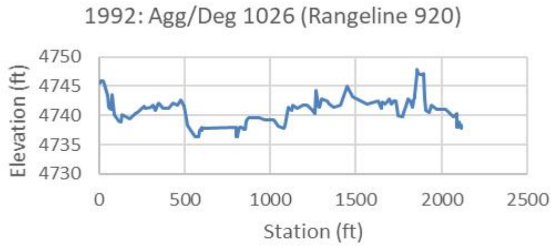


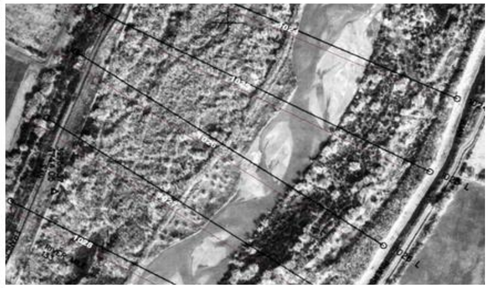


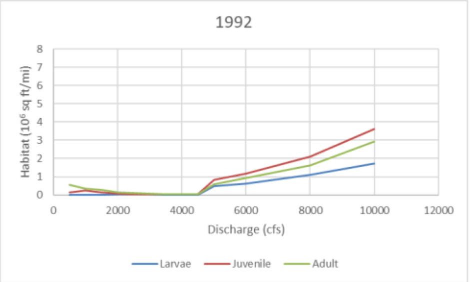


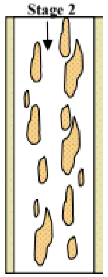


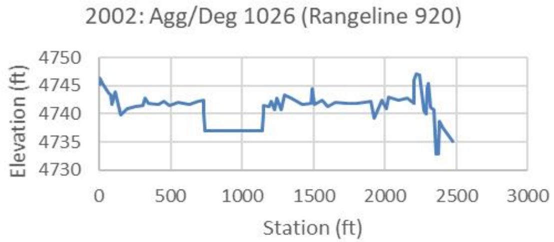


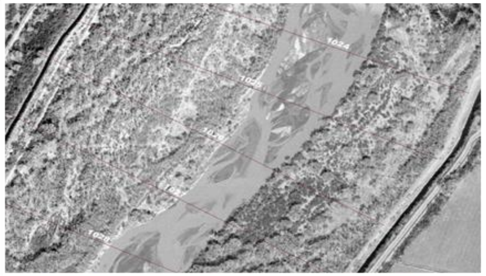


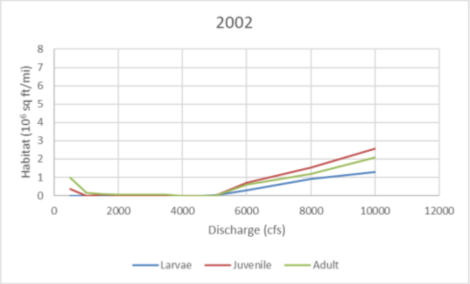


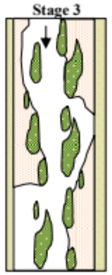


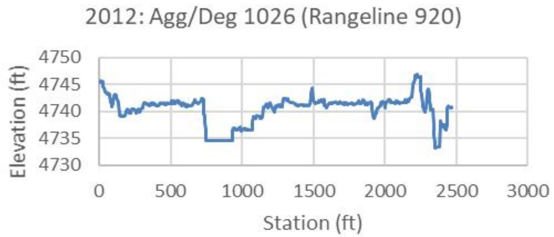


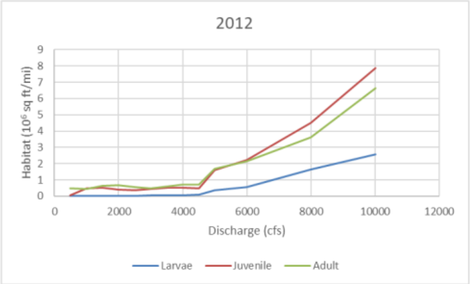


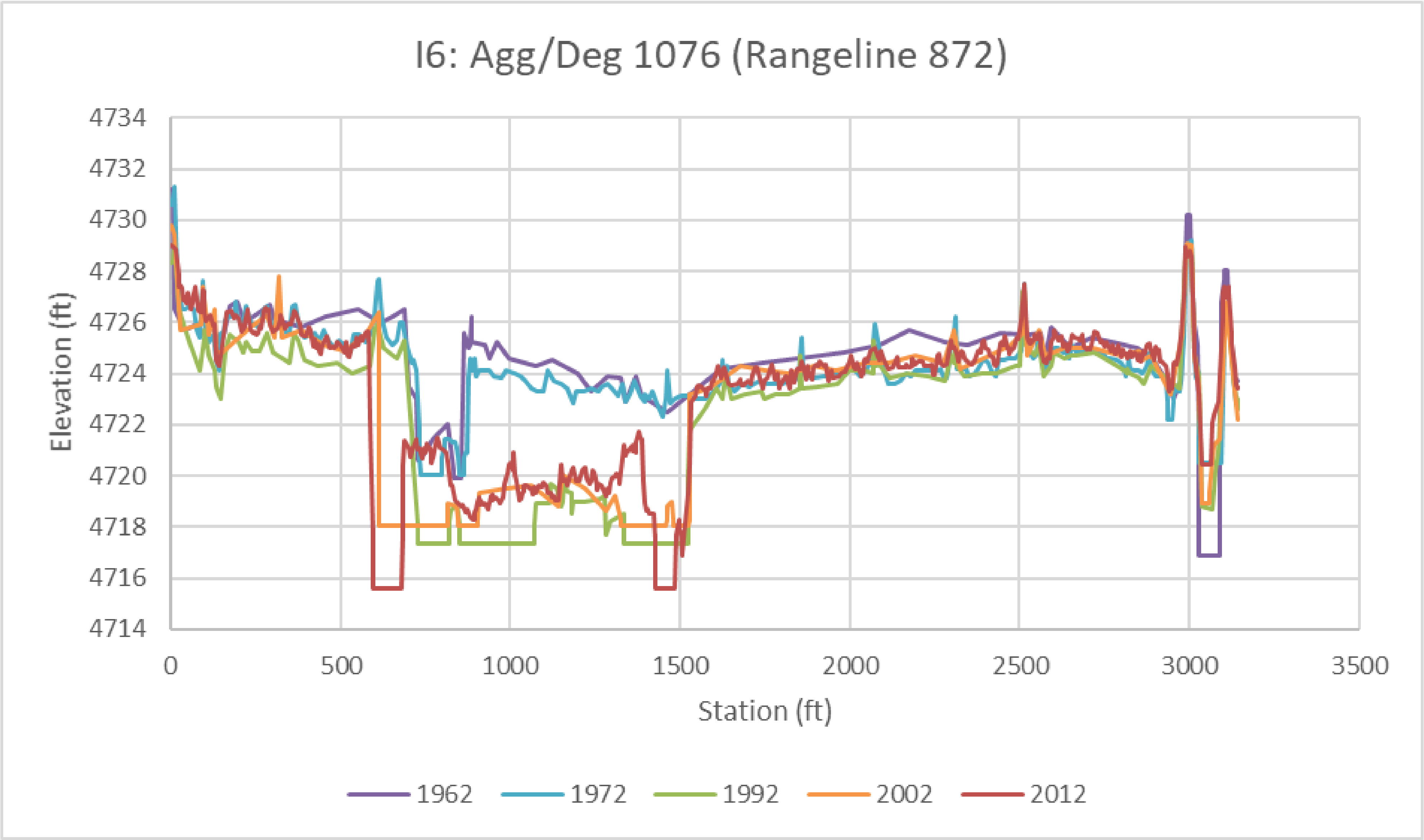






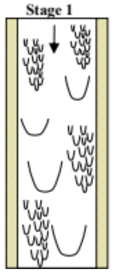


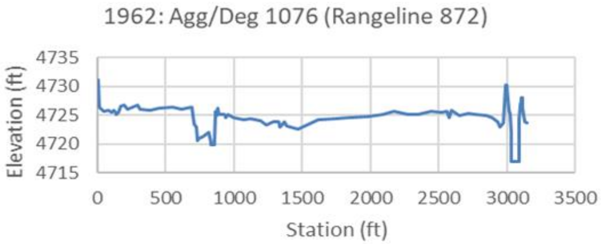


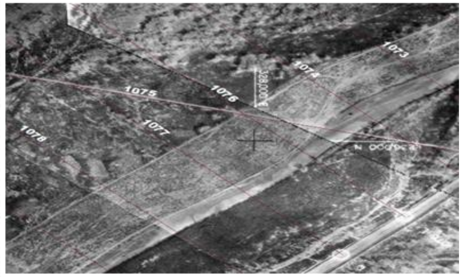


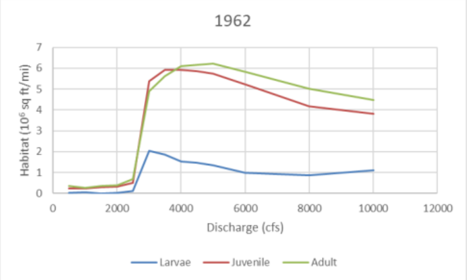
I6: Agg/Deg 1076 (Rangeline 872)
4734
4732
4730
4728
4726
4724
4722
4720
4718
4716
4714
Elevation (ft)
0
500
1000
1500
2000
2500
3000
3500
Station (ft)
1962
1972
1992
2002
2012

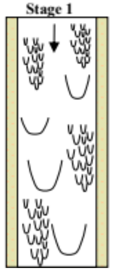
Isleta
Sub-reach I6

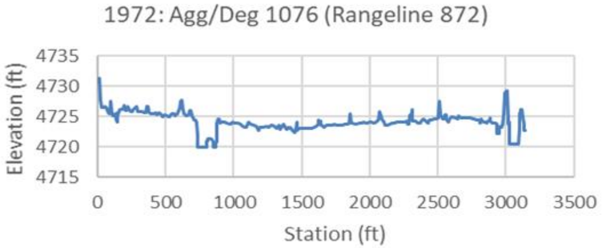


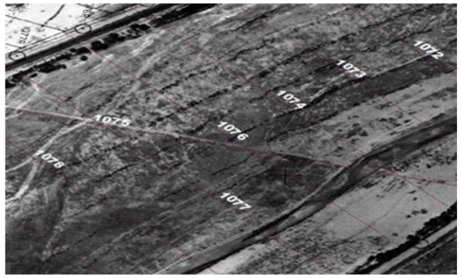


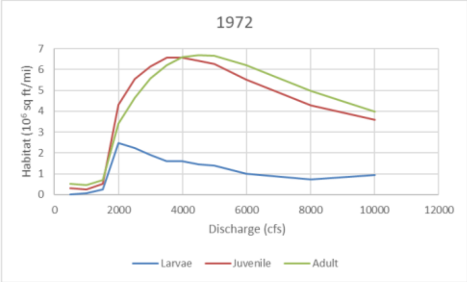


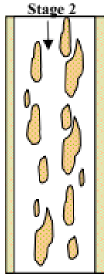


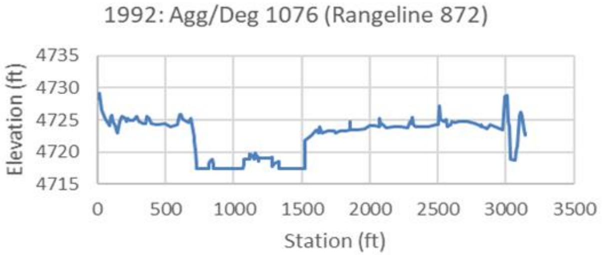


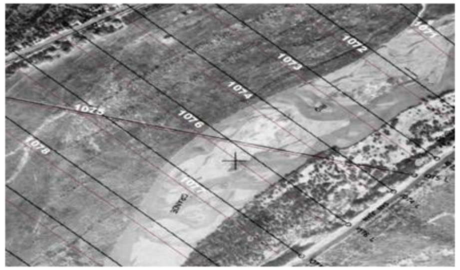


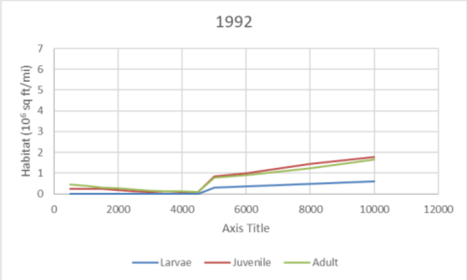


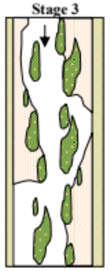


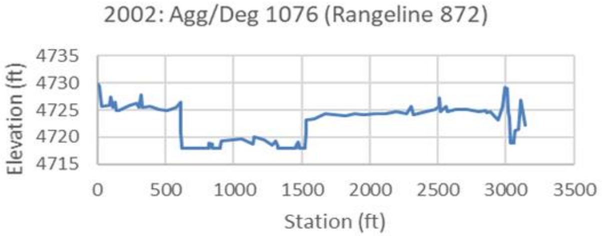


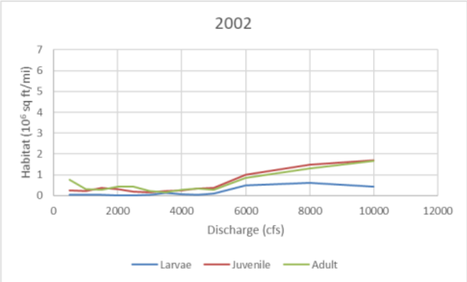


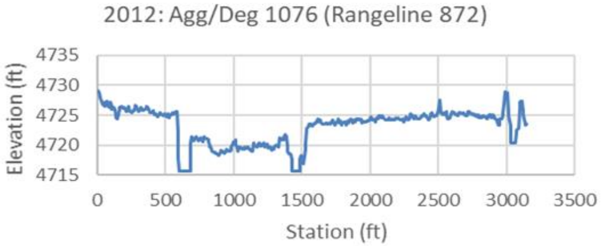


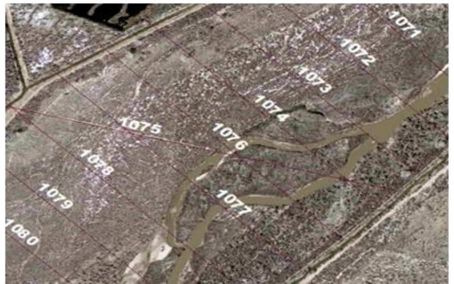


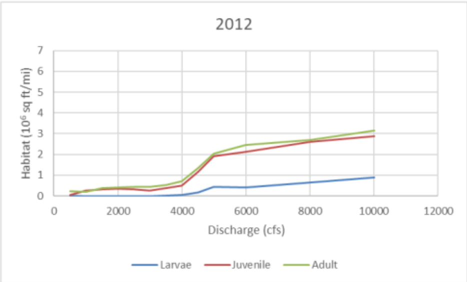




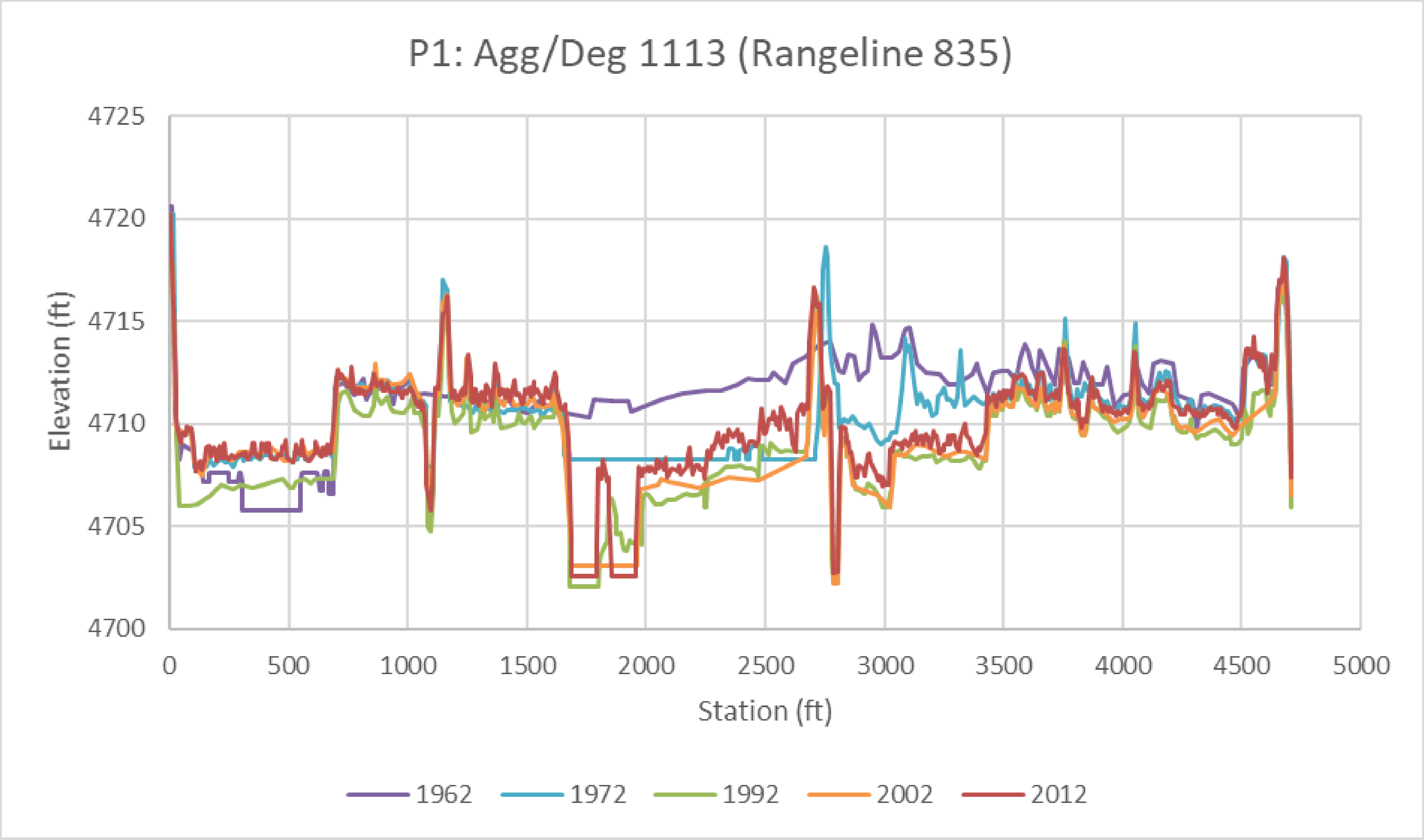






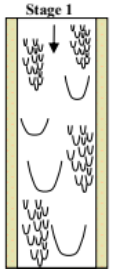


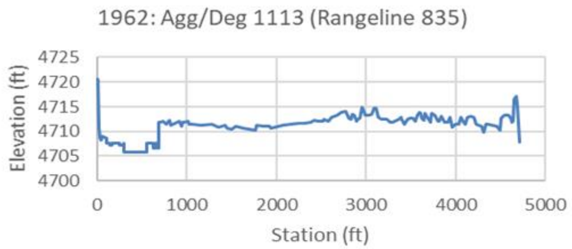
Rio Puerco

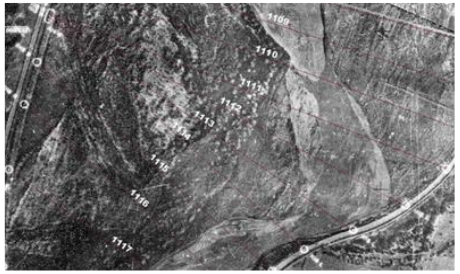


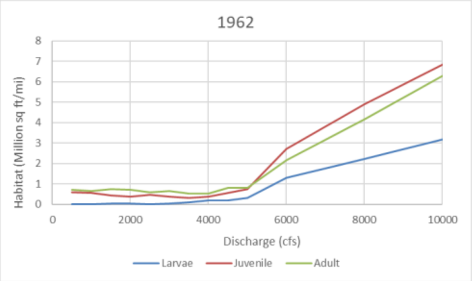
P1: Agg/Deg 1113 (Rangeline 835)
4725
4720
4715
4710
4705
4700
Elevation (ft)
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
Station (ft)
1962
1972
1992
2002
2012

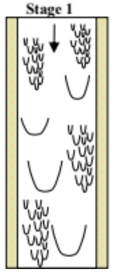
Rio Puerco Sub-reach P1

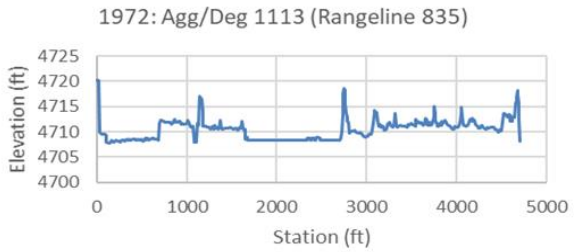


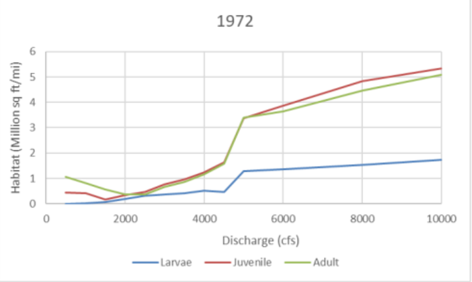


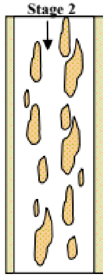


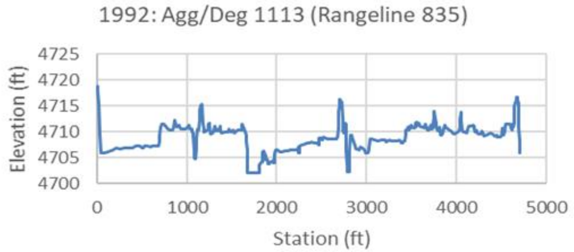


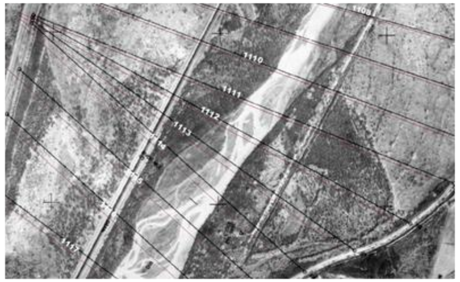


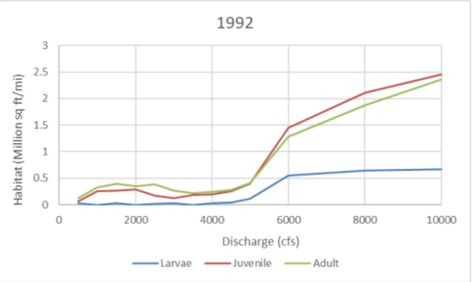


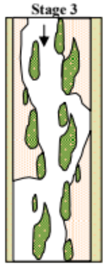


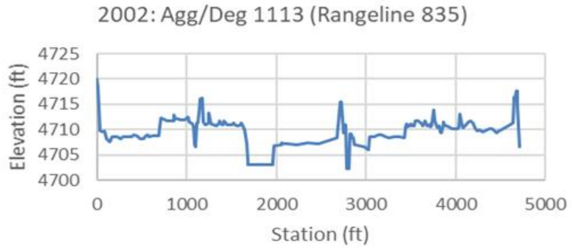


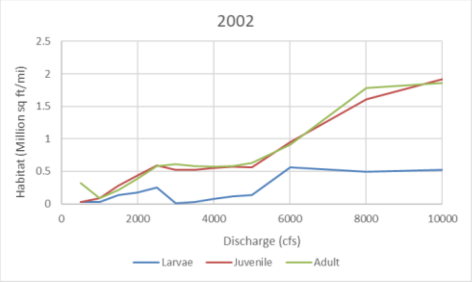


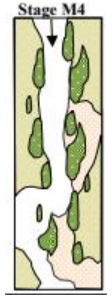


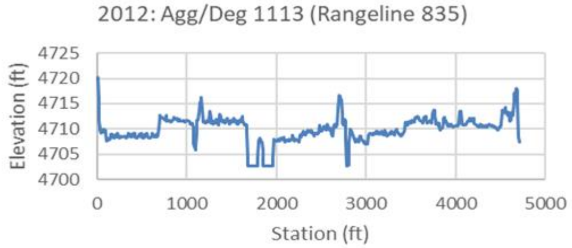


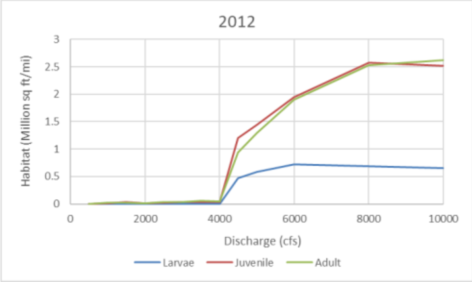


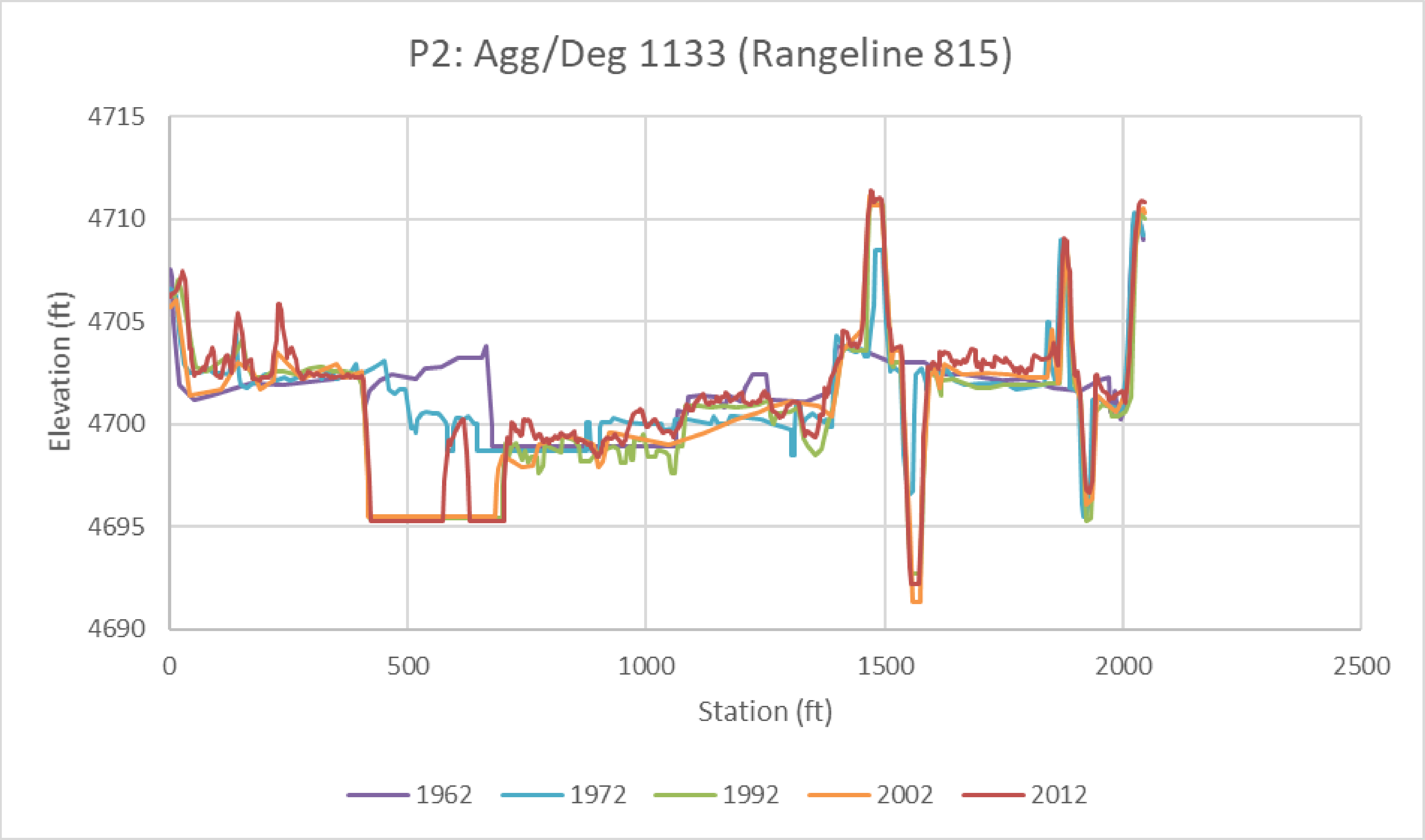




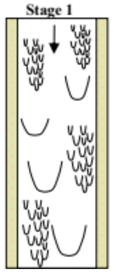


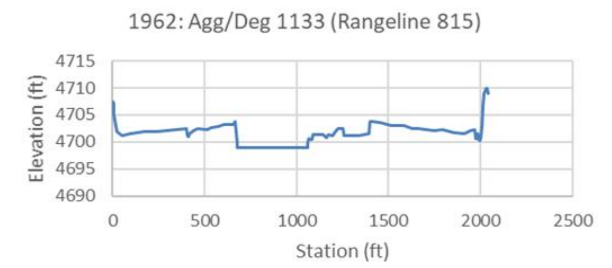


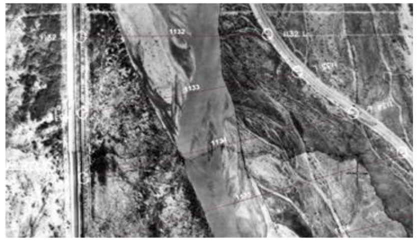


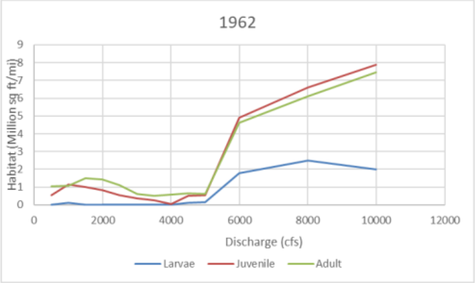

P2: Agg/Deg 1133 (Rangeline 815)
Elevation (ft)
4715
4710
4705
4700
4695
4690
0
500
1000
1500
2000
2500
Station (ft)
1962
1972
1992
2002
2012

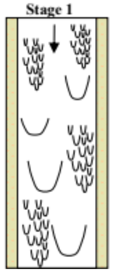
Rio Puerco Sub-reach P2

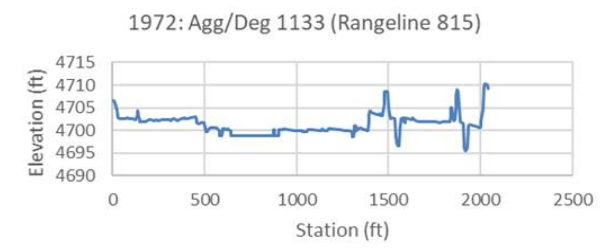


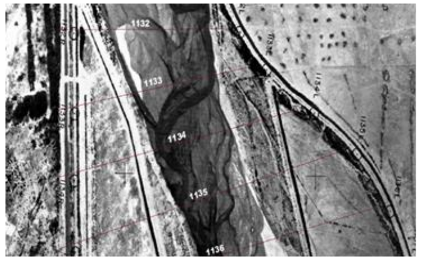


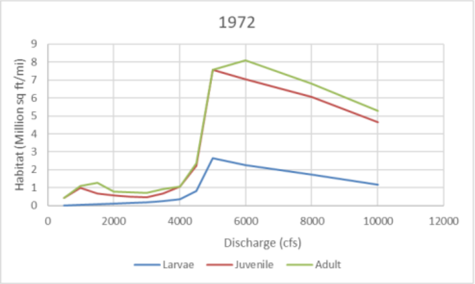


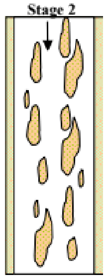


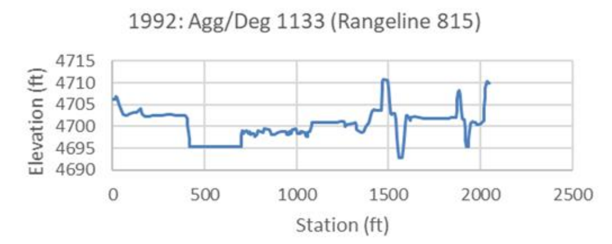


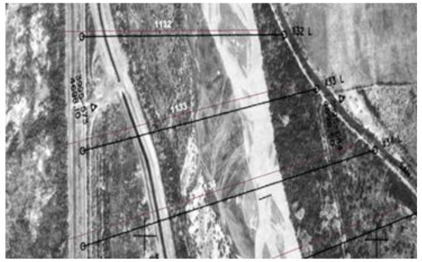


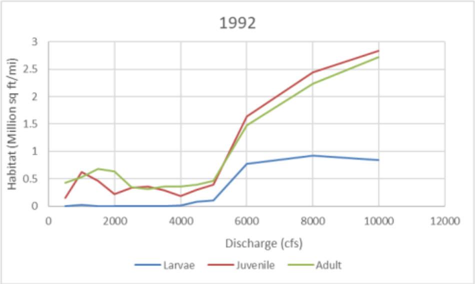


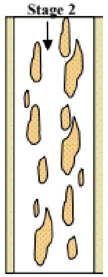


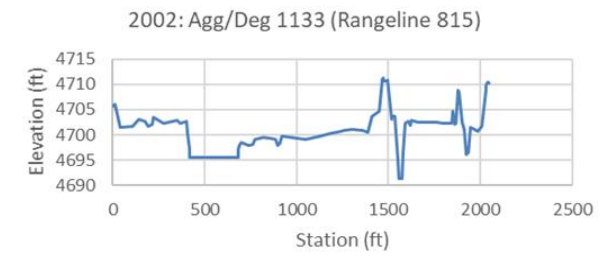


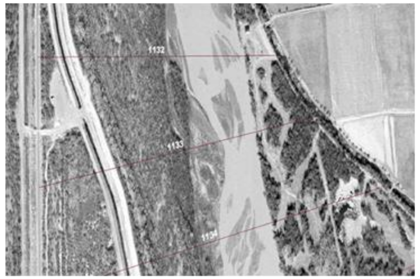


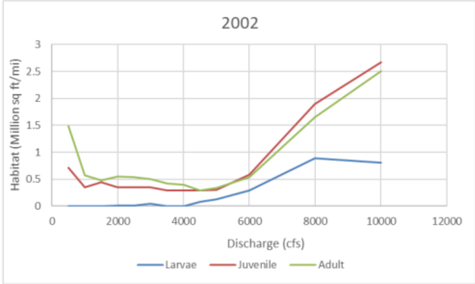


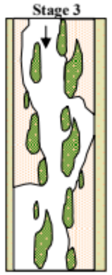


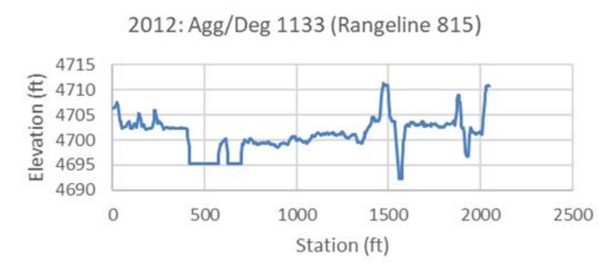


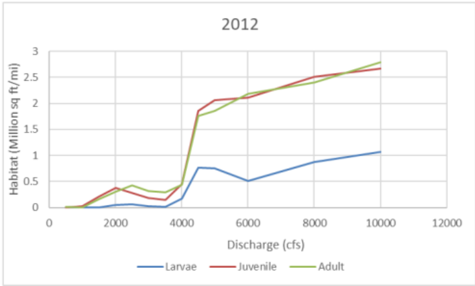


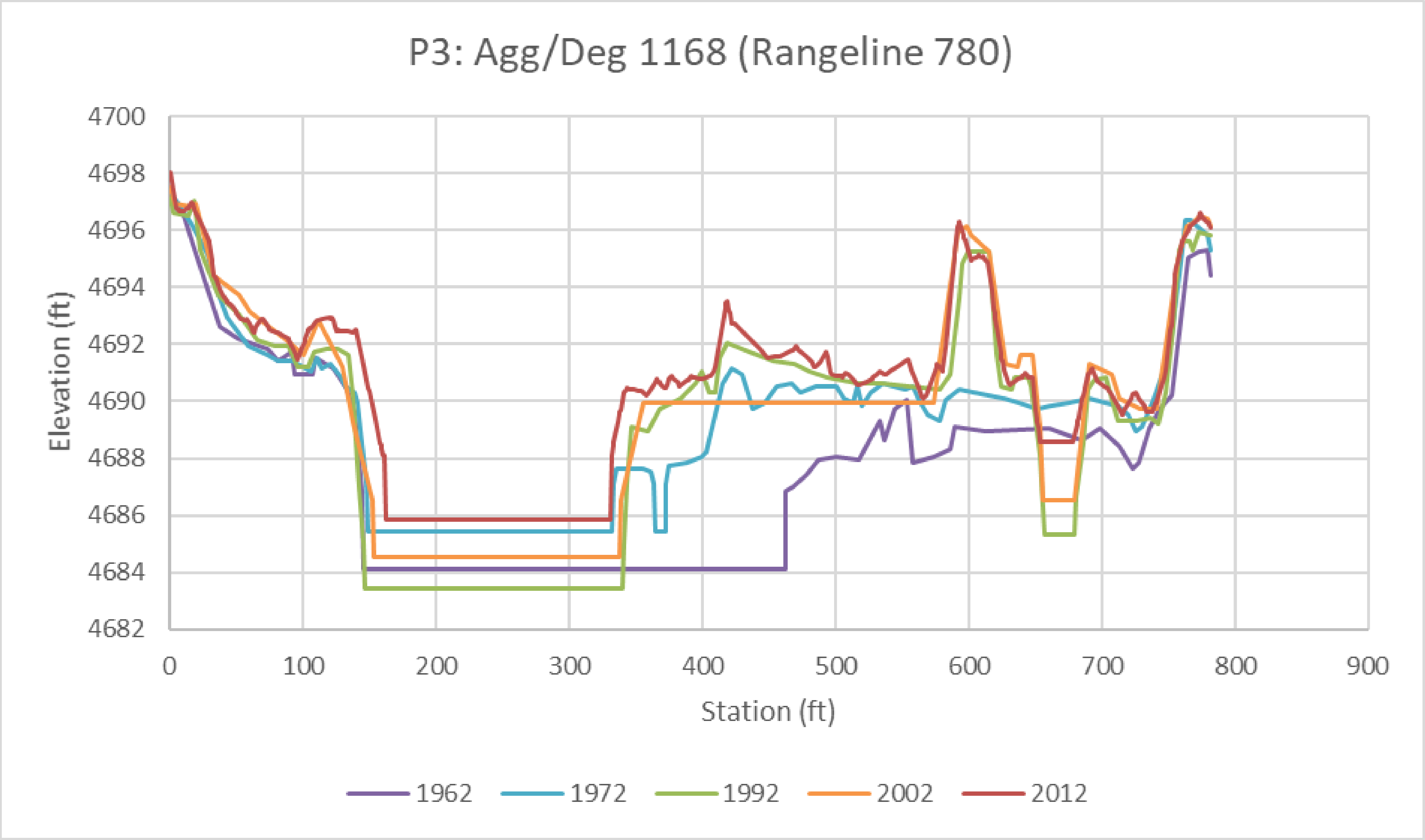




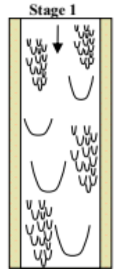


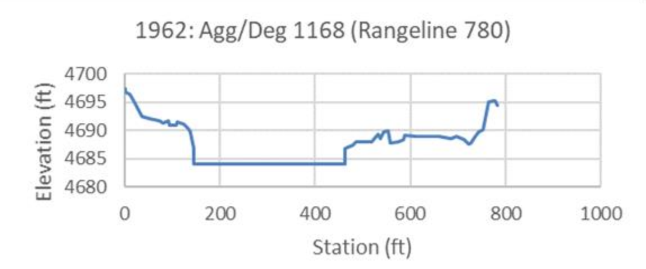


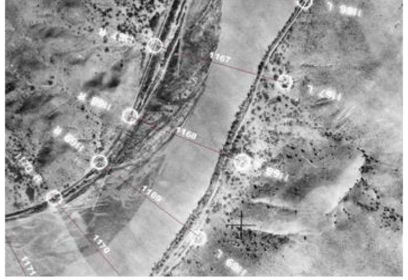


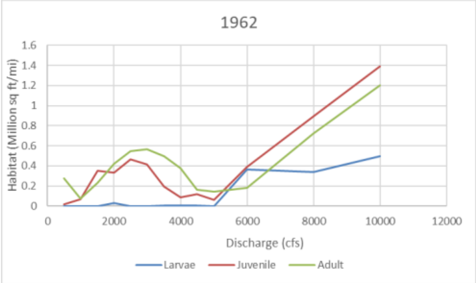

P3: Agg/Deg 1168 (Rangeline 780)
Elevation (ft)
4700
4698
4696
4694
4692
4690
4688
4686
4684
4682
0
100
200
300
400
500
600
700
800
900
Station (ft)
1962
1972
1992
2002
2012

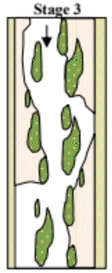
Rio Puerco
Sub-reach P3

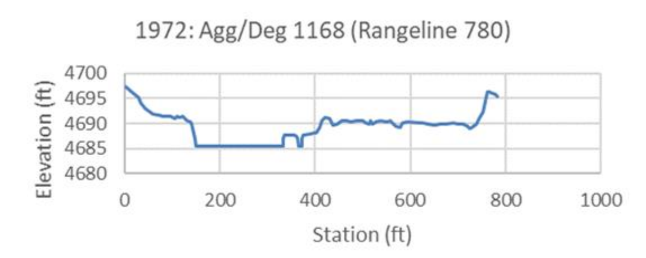


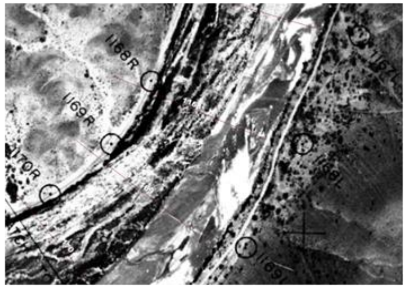


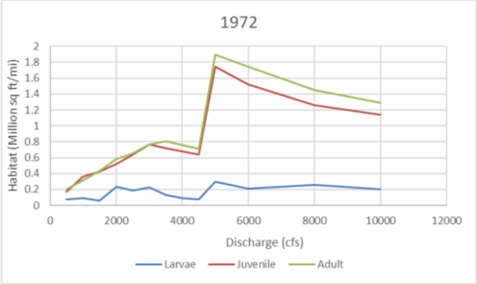


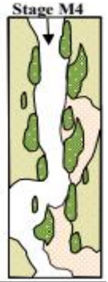


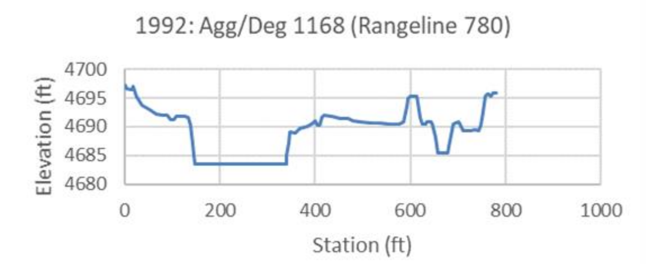


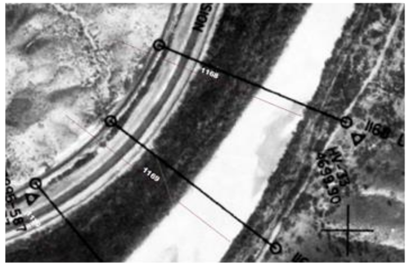


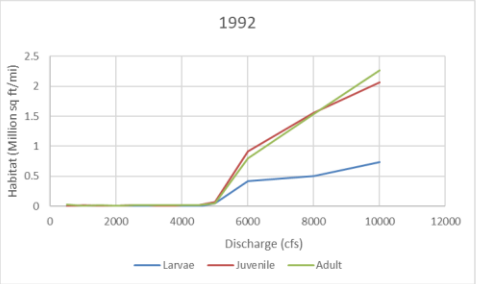


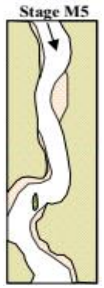


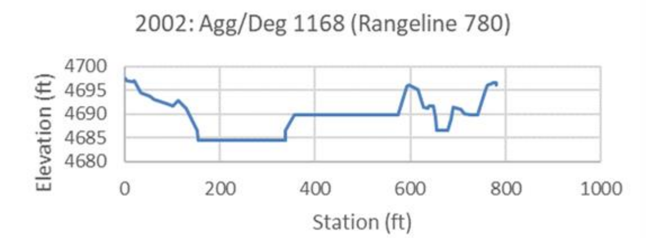


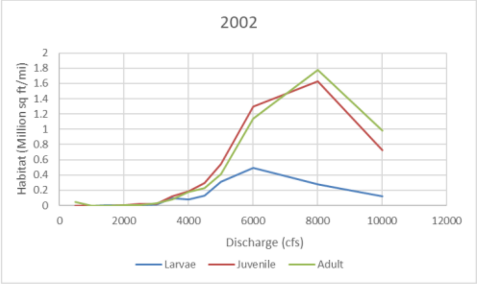


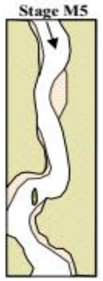


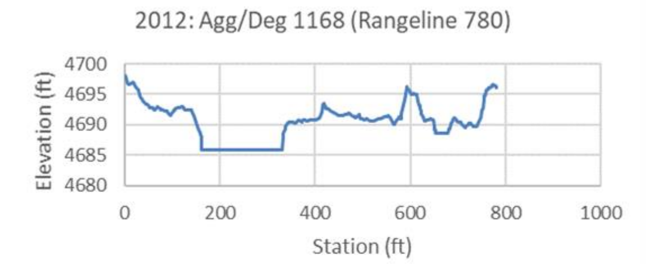


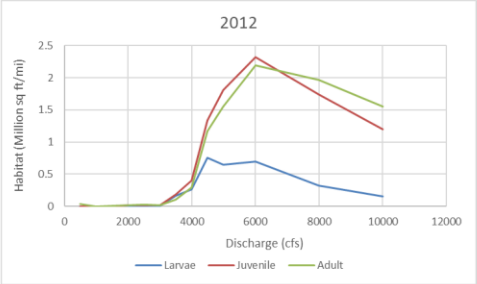


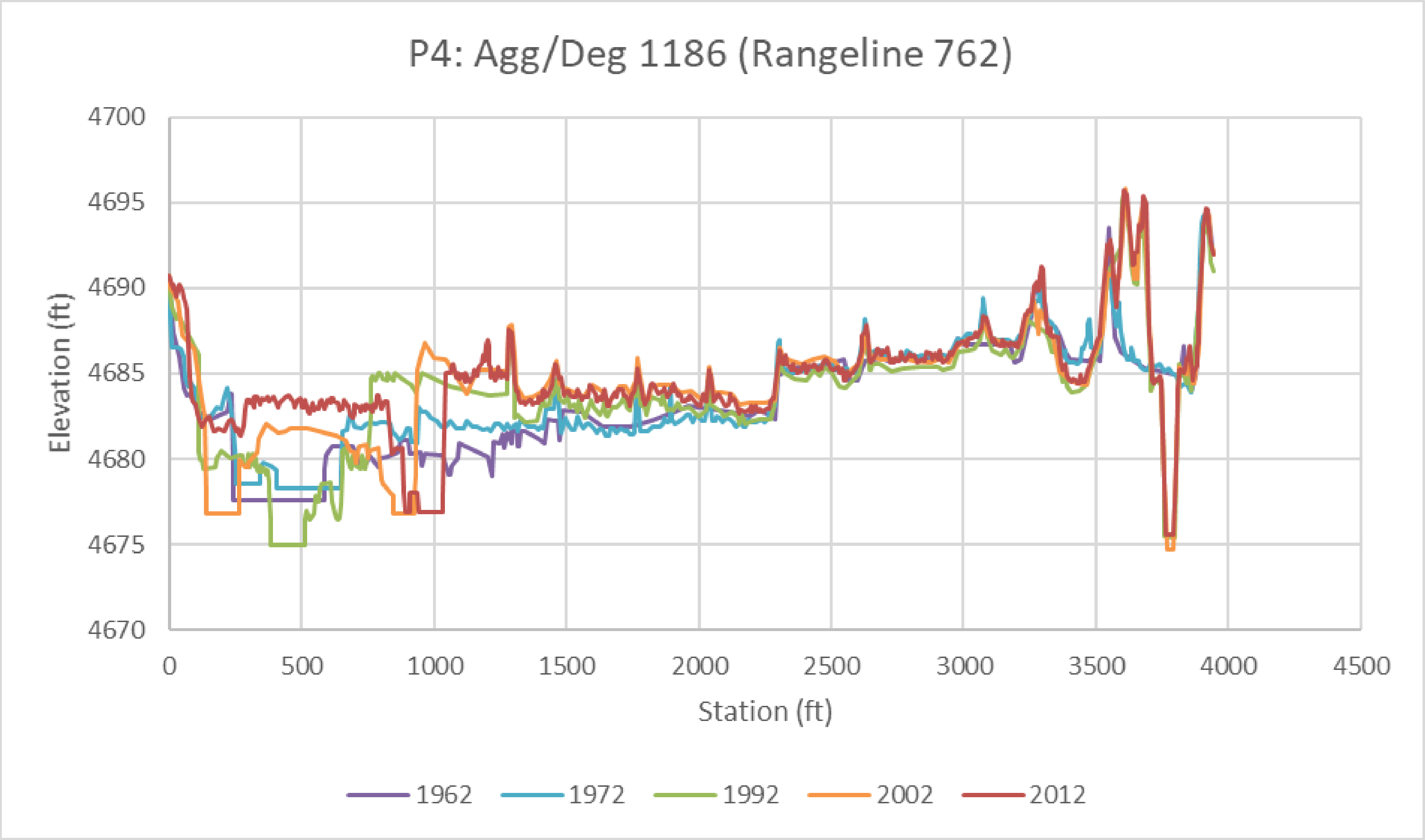




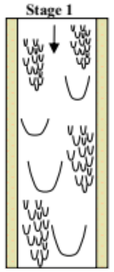


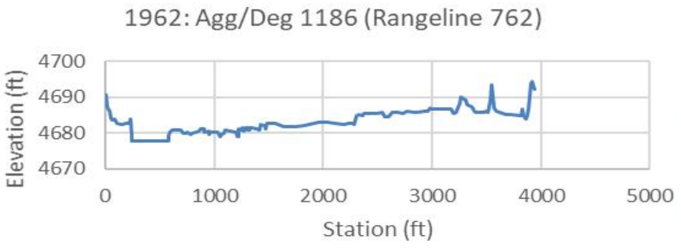


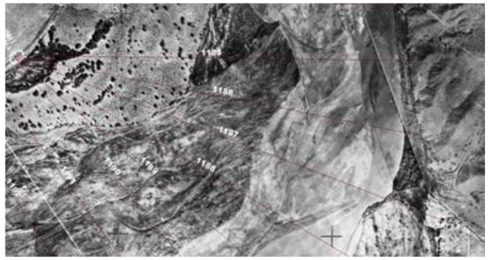


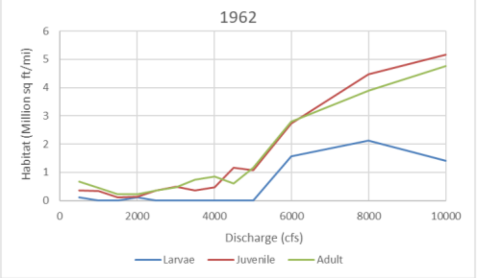

P4: Agg/Deg 1186 (Rangeline 762)
Elevation (ft)
4700
4695
4690
4685
4680
4675
4670
0
500
1000
1500
2000
2500
3000
3500
4000
4500
Station (ft)
1962
1972
1992
2002
2012

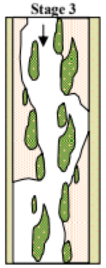
Rio Puerco
Sub-reach P4

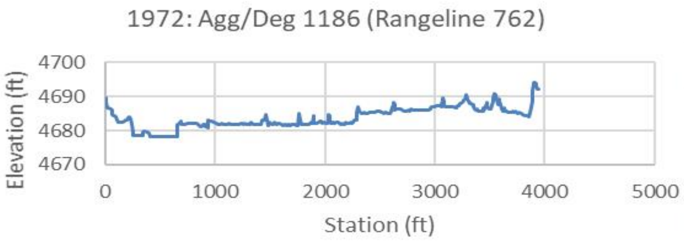


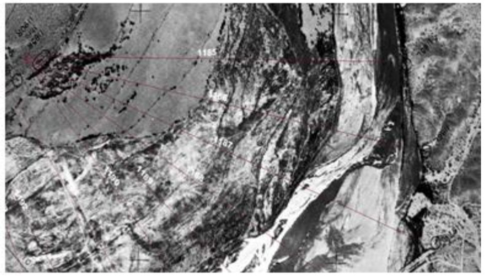


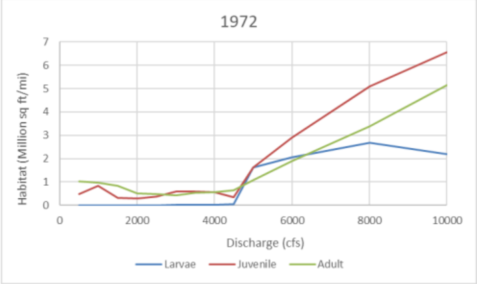


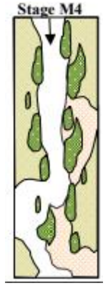


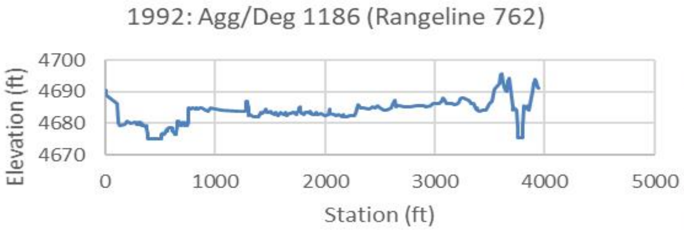


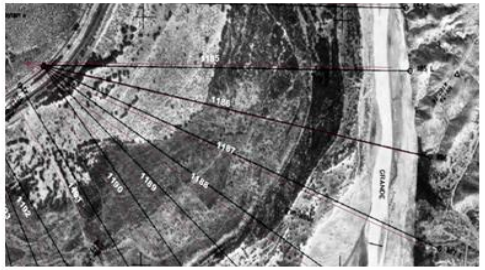


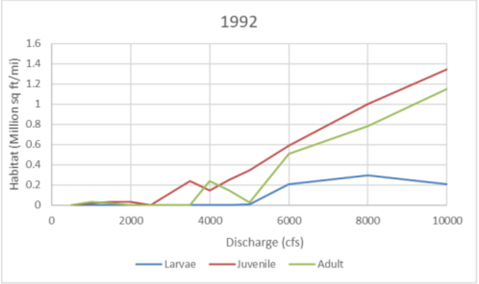


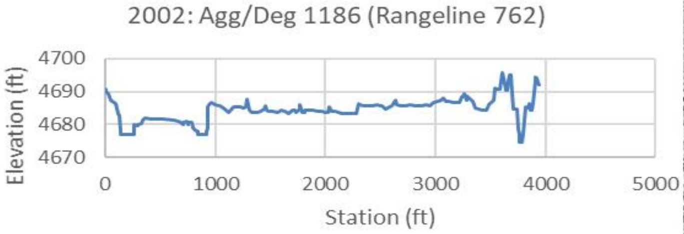


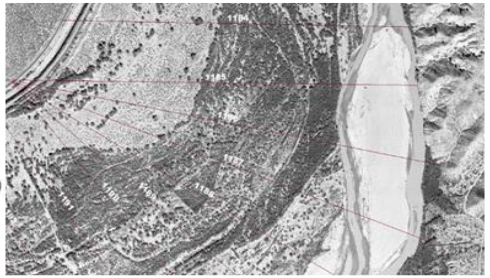


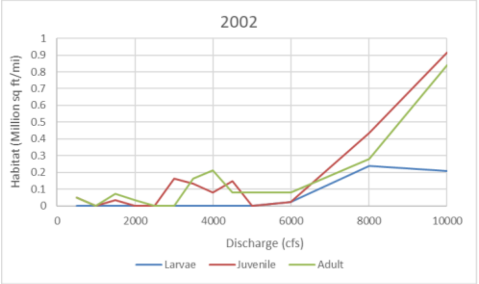


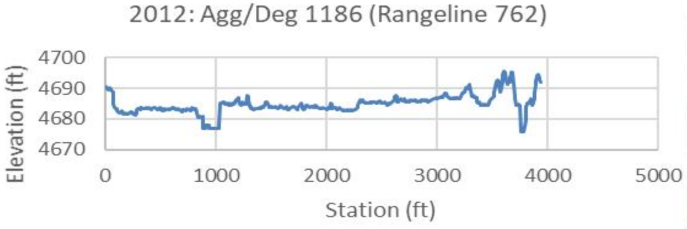


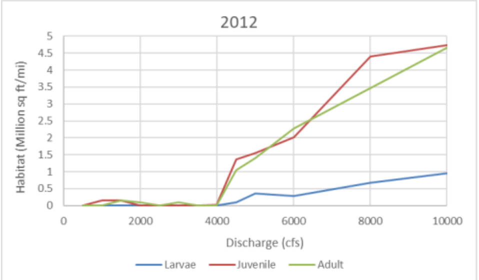


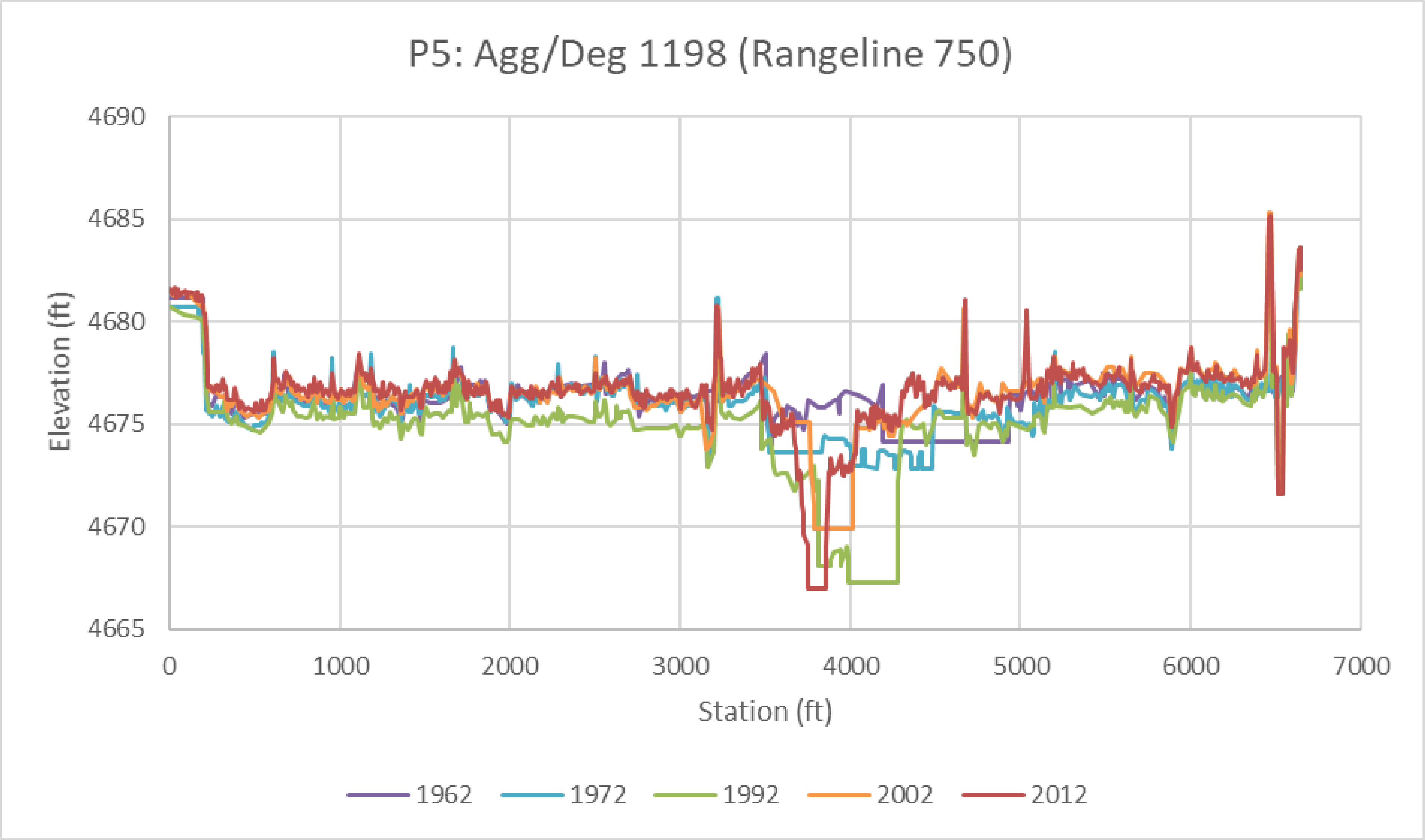






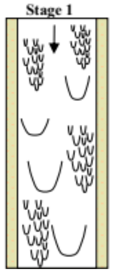


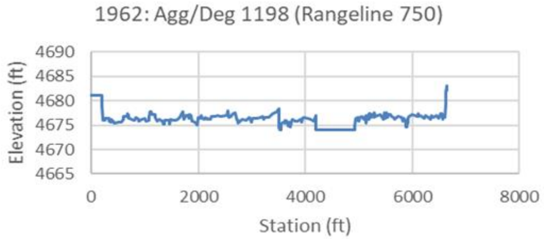


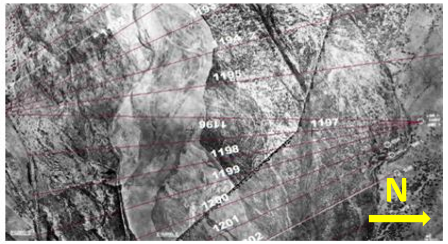


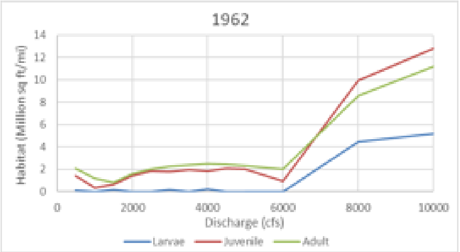
P5: Agg/Deg 1198 (Rangeline 750)
4690
4685
4680
4675
4670
4665
Elevation (ft)
0
1000
2000
3000
4000
5000
6000
7000
Station (ft)
1962
1972
1992
2002
2012

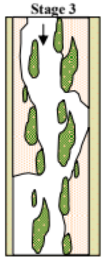
Rio Puerco
Sub-reach P5

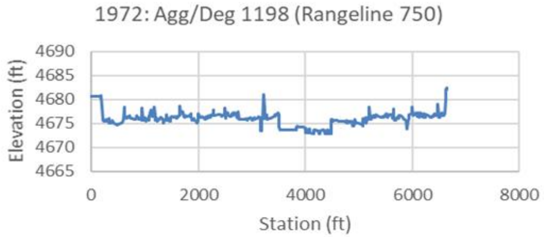


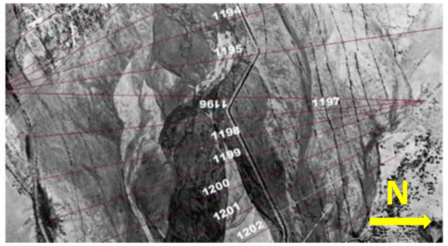


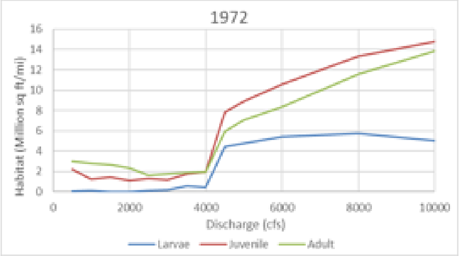


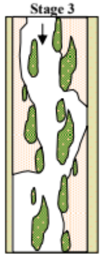


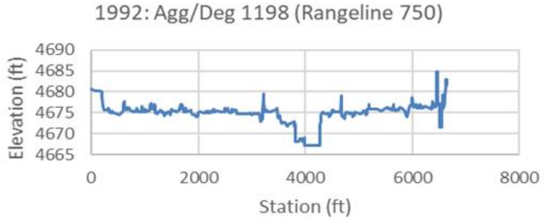


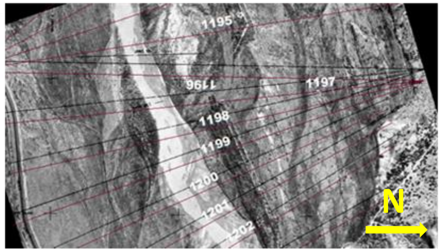


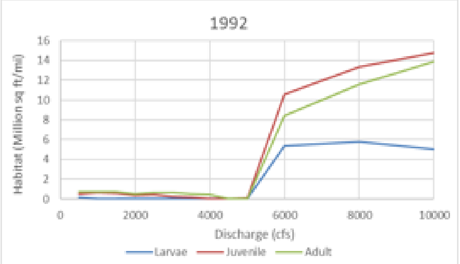


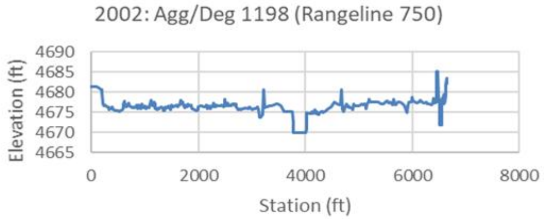


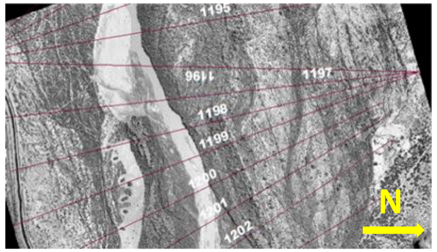


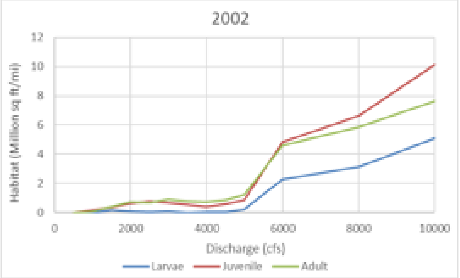


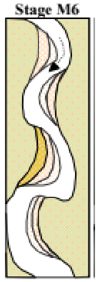


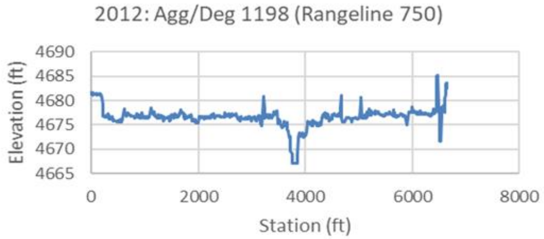


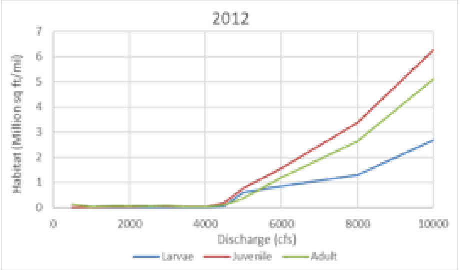










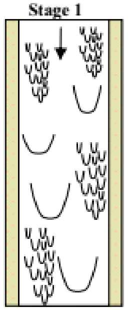


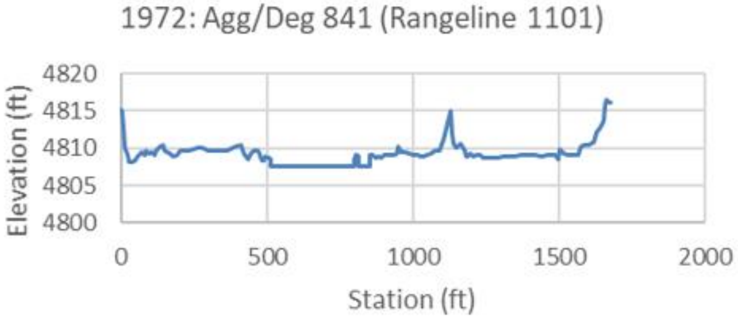
Isleta	Geomorphic Stage Classification				
Subreach	**1962**	**1972**	**1992**	**2002**	**2012**
I1	1	1	2	2	M5
I2	1	1	2	3	M4
I3	1	1	2	M7	M8
I4	1	1	3	M5	M5
I5	1	1	2	2	3
I6	1	1	2	3	M4

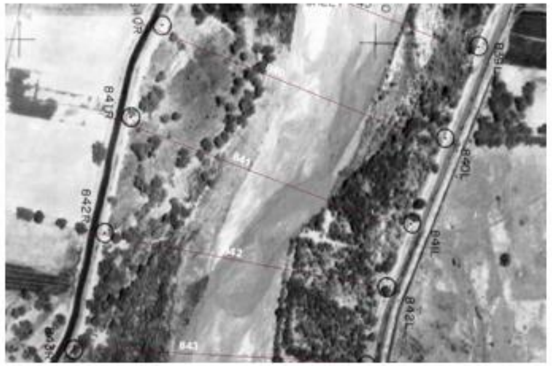
Rio Puerco	Geomorphic Stage Classification				
Subreach	**1962**	**1972**	**1992**	**2002**	**2012**
P1	1	1	2	3	M4
P2	1	1	2	2	3
P3	1	3	M4	M5	M5
P4	1	3	M4	M7	M8
P5	1	3	3	M4	M6

Typical Patterns

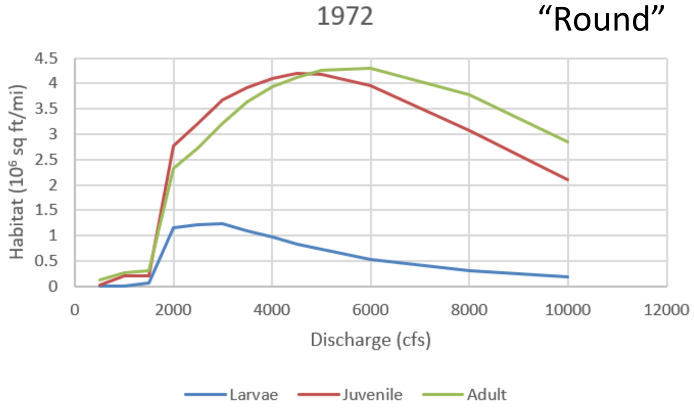
Sub-reach I3



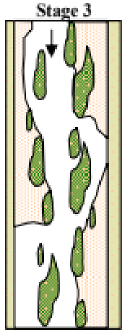


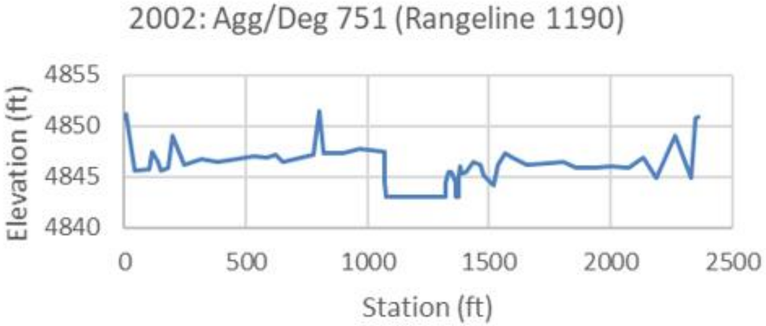


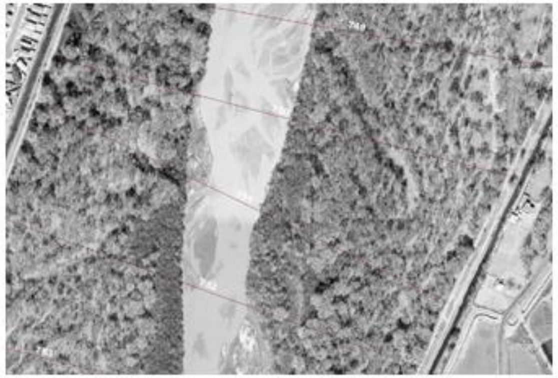
“Round”



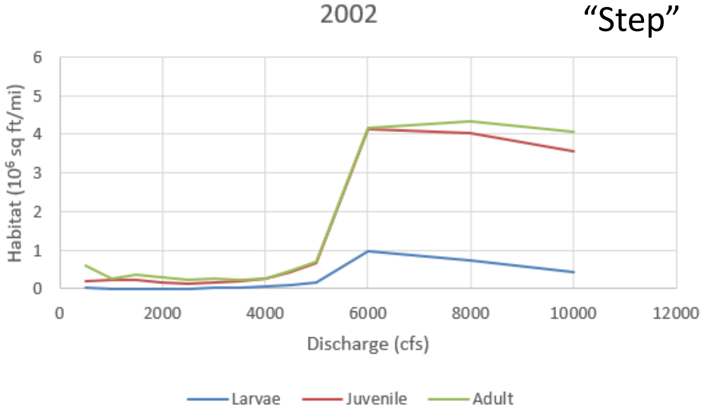
Sub-reach I2



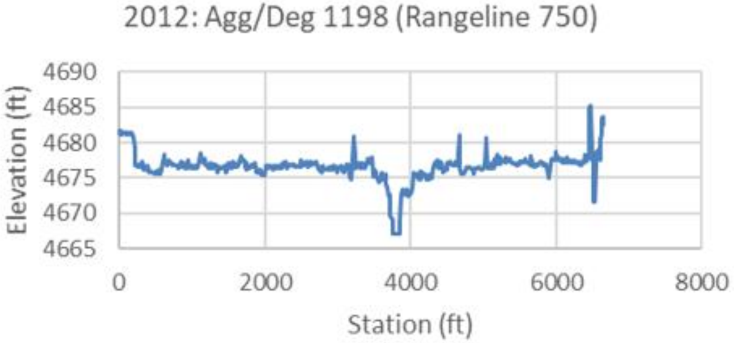




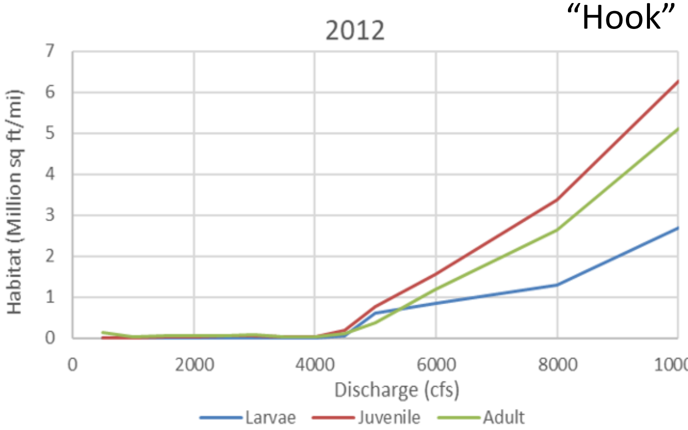
“Step”



Sub-reach P5



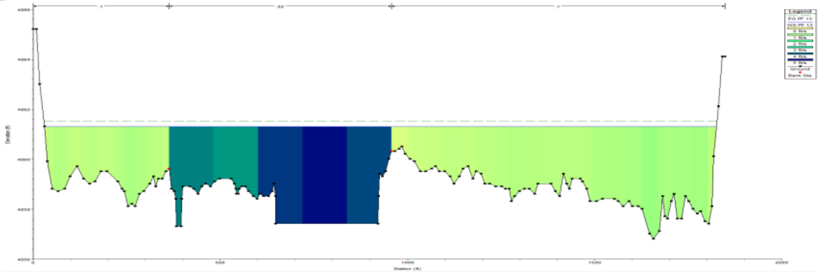
“Hook”



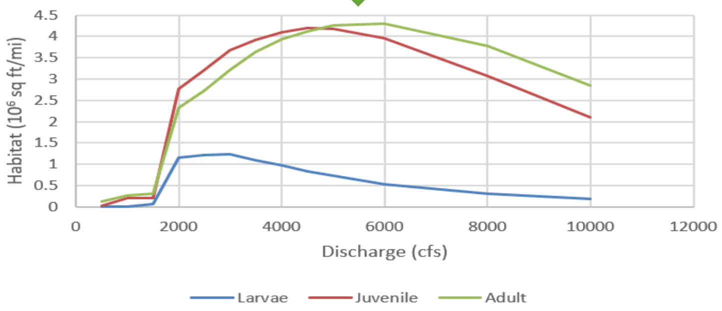
Contents

Habitat Curves From Width-Slice Method

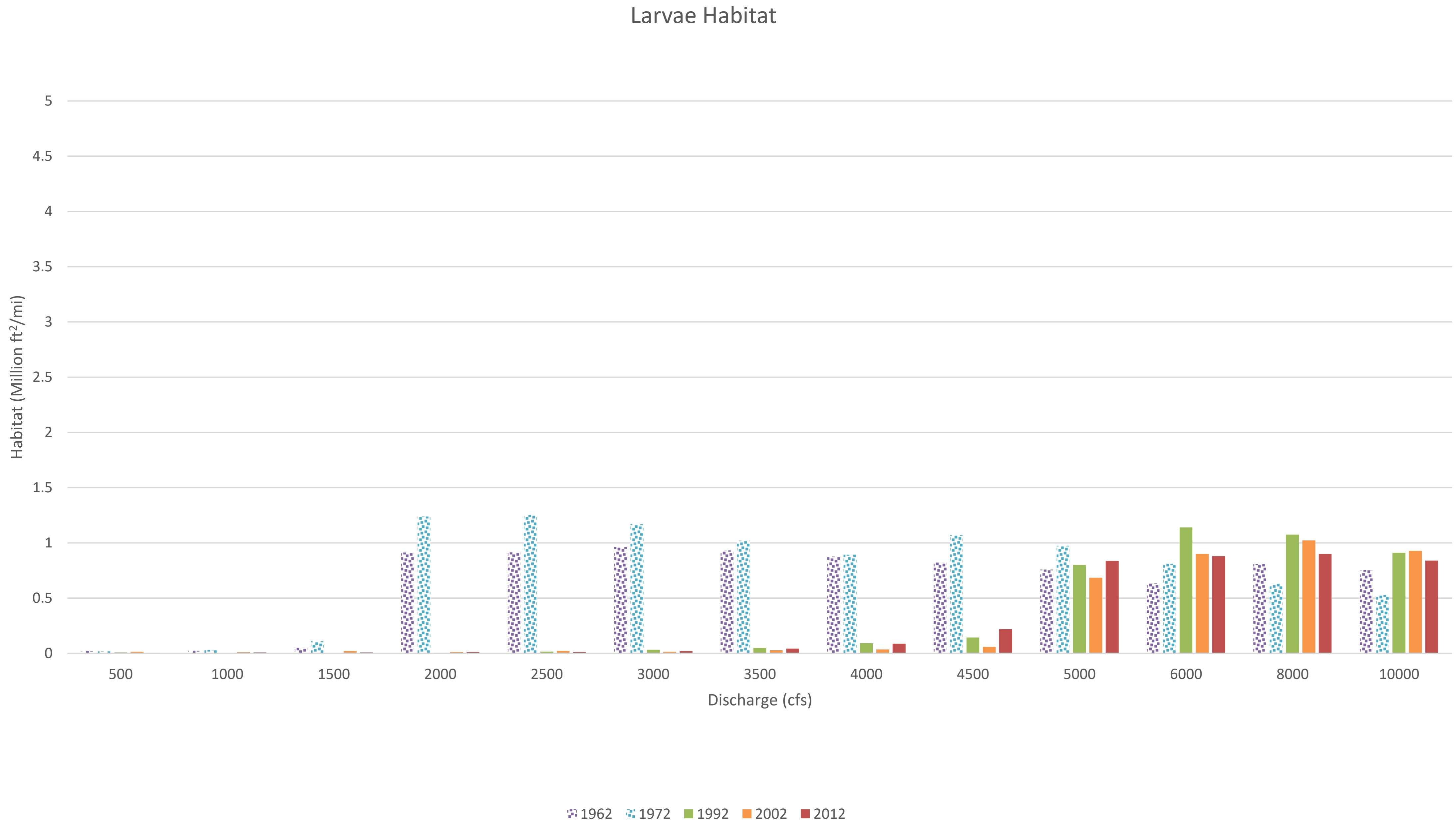
- HEC-RAS steady flow analysis for years 1962, ‘72, ‘92, 2002, and 2012. Flow distribution data with 20 width-slices assigned to the floodplain and 5 slices to the channel in HEC-RAS.
- In excel, data for each cross-section is analyzed to determine how many slices meet the RGSM depth and velocity criteria for each life stage.
- A width of suitable habitat is obtained, multiplied by 500 ft (distance between agg/deg lines) and normalized based on the length of the reach.



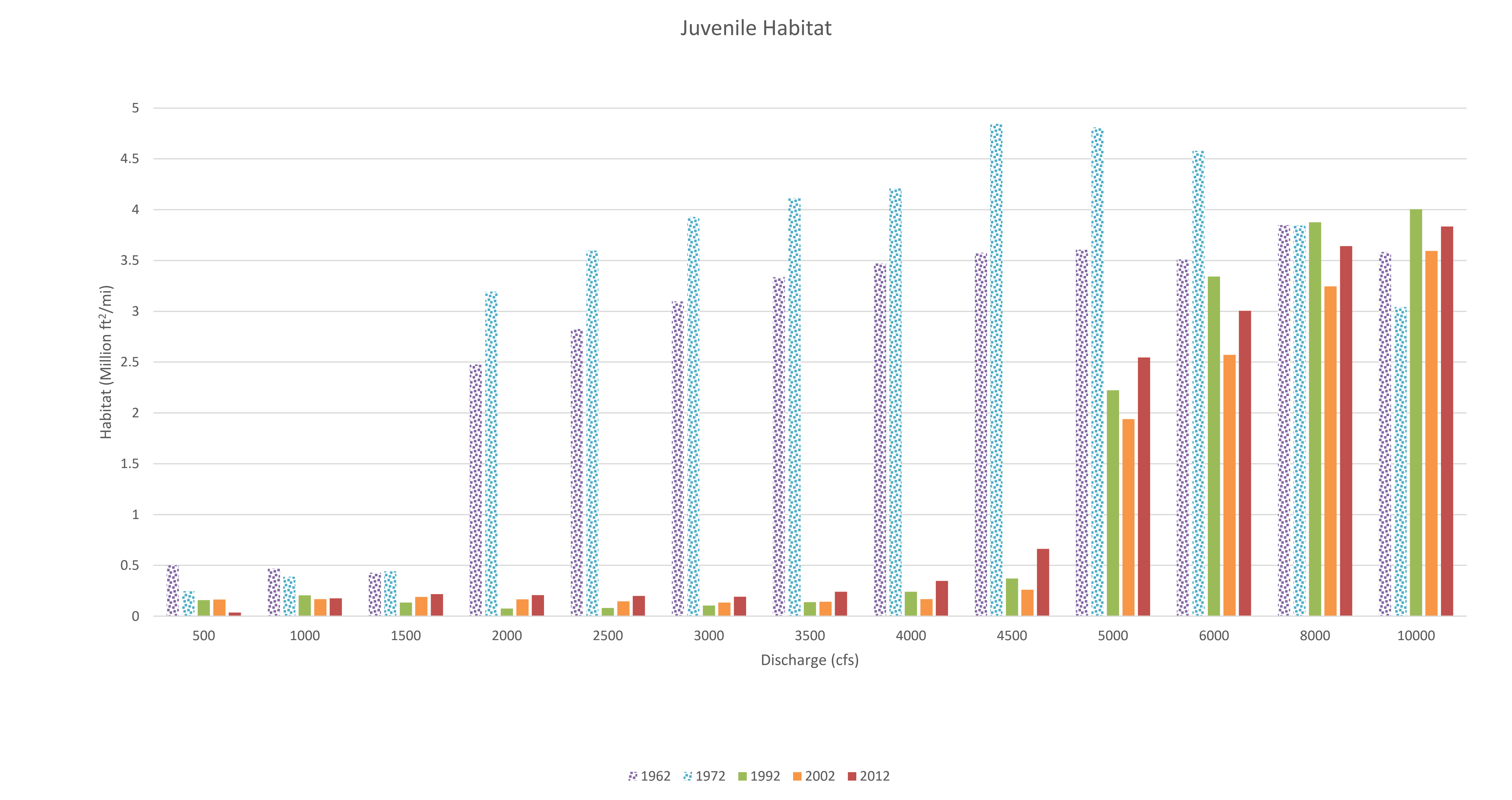
Stage	Velocity (cm/s)	Depth (cm)
Larvae	0-5	0-15
Juvenile	0-30	1-50
Adult	0-40	5-60



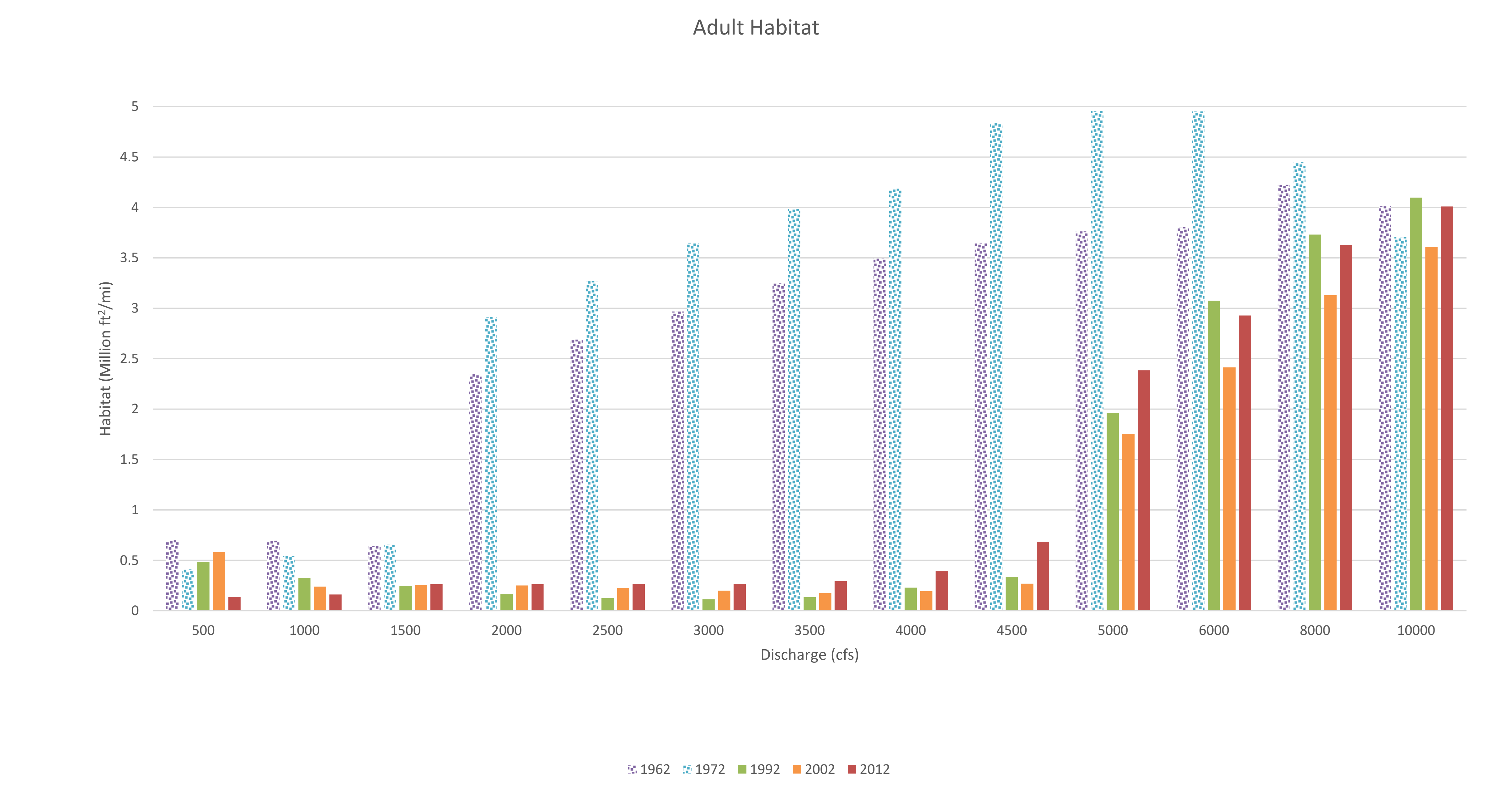
Isleta and Rio Puerco Combined Habitat Curves



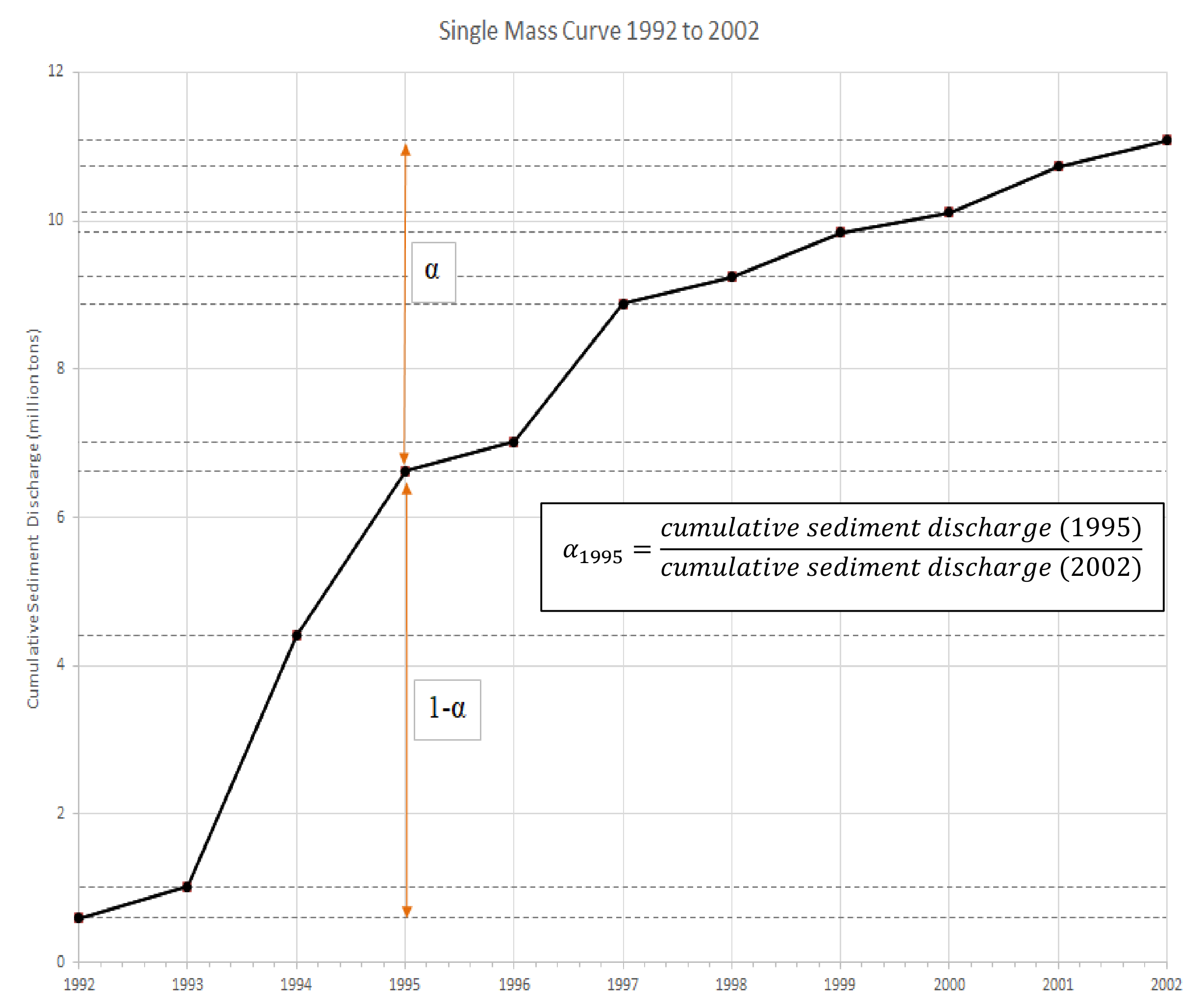
Isleta and Rio Puerco Combined Habitat Curves

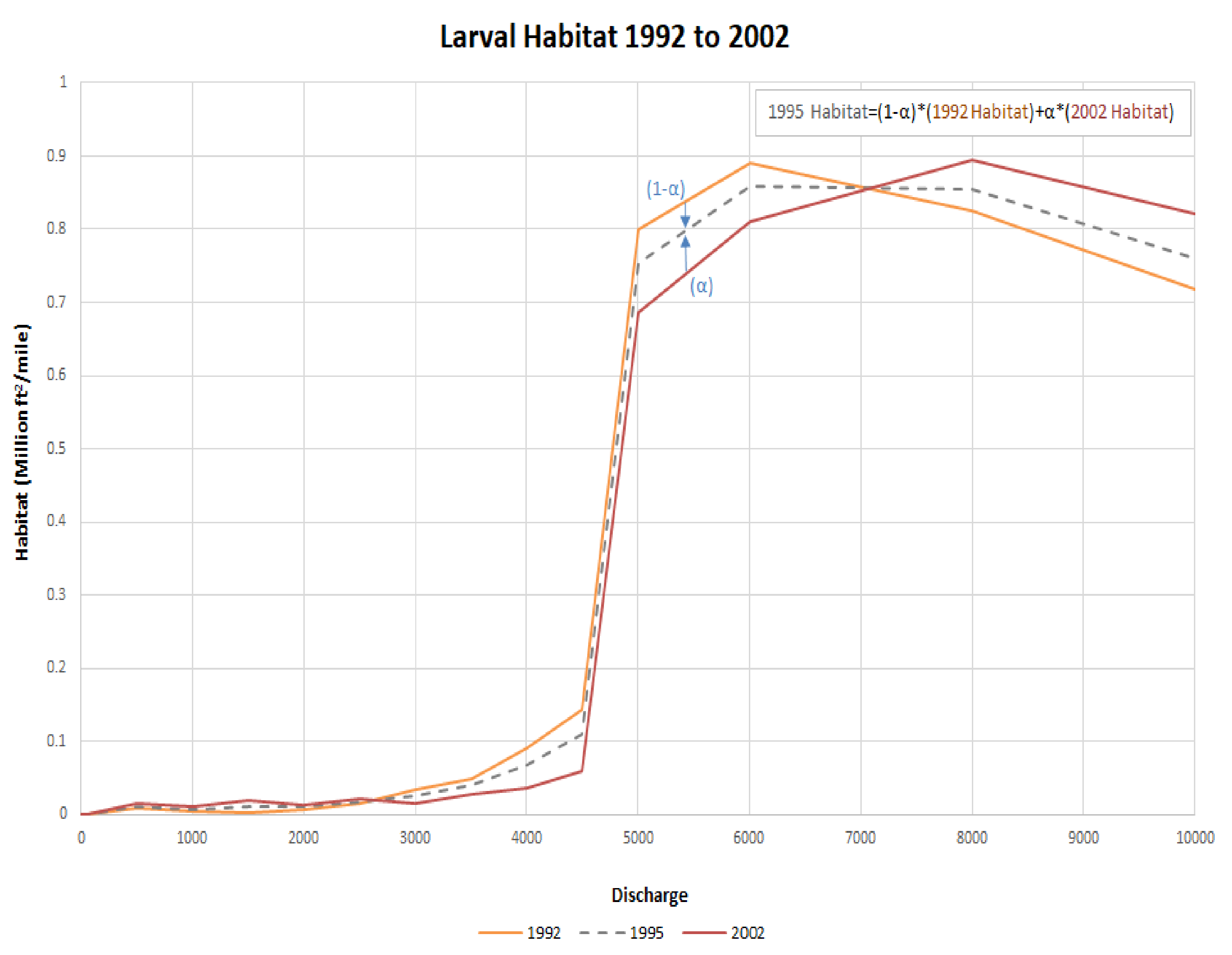


Isleta and Rio Puerco Combined Habitat Curves



Temporal Interpolation of Flow-Habitat Curves





Time Integrated Habitat Metric (TIHM)

Macro calculates amount of habitat on that day

Input	Calculation

Larvae Habitat Curve (Escondida Reach)		Interpolation	
Discharge (cfs)	Habitat Area (ft^2/mile)	m	b
0	0	-	-
50	0	0.00	0.00
500	27208	60.46	-3023.07
1000	30149	5.88	24266.56
1500	19784	-20.73	50877.39
2000	105961	172.35	-238746.82
2500	106583	1.24	103476.11
3000	120344	27.52	37778.66
3500	143734	46.78	-19999.04
4000	213072	138.68	-341633.44
4500	209122	-7.90	244672.29
5000	189498	-39.25	385742.99

Cut-off discharge

Calculate Habitat Lengths

	USGS Gage Data			
Month	Date	Discharge (cfs)	Habitat Area (ft^2/mile)	Habitat Area Moving Average
10	10/1/2011	20.5	0	
10	10/2/2011	21.3	0	
10	10/3/2011	19.7	0	
10	10/4/2011	15	0	
10	10/5/2011	180	7860	
10	10/6/2011	123	4414	
10	10/7/2011	133	5018	2470
10	10/8/2011	293	14692	4569
10	10/9/2011	221	10339	6046
10	10/10/2011	224	10520	7549
10	10/11/2011	222	10399	9035
10	10/12/2011	178	7739	9017
10	10/13/2011	157	6469	9311
10	10/14/2011	110	3628	9112
10	10/15/2011	150	6046	7877
10	10/16/2011	151	6107	7273
10	10/17/2011	170	7255	6806
10	10/18/2011	121	4293	5934
10	10/19/2011	92.6	2576	[illegible]
10	10/20/2011	90.3	2437	[illegible]
10	10/21/2011	62.6	762	[illegible]
10	10/22/2011	72.4	1354	[illegible]
10	10/23/2011	55	302	2711
10	10/24/2011	71.2	1282	1858
10	10/29/2011	69.4	1173	745
10	10/30/2011	110	3628	1220
10	10/31/2011	219	10218	2497
11	11/1/2011	343	17715	4883
11	11/2/2011	429	22915	8025
11	11/3/2011	503	27225	11876
11	11/4/2011	535	27414	15755
11	11/5/2011	556	27537	19522
11	11/6/2011	591	27743	22967
11	11/7/2011	641	28037	25512
11	11/8/2011	657	28131	27000
11	11/9/2011	634	27996	27726
11	11/10/2011	726	28537	27914
11	11/11/2011	764	28761	28106
11	11/12/2011	807	29013	28317

Linear interpolation between discharges

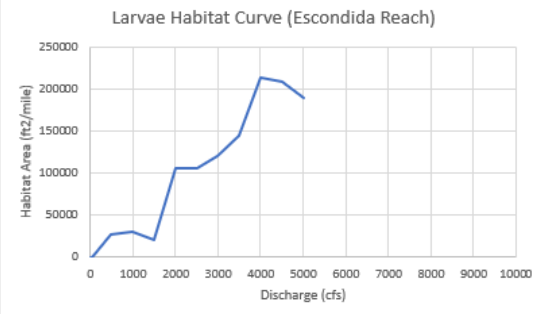
Month	Total Habitat (ft^2/mile)
10	130971.6
11	851965.1
12	902225.0
1	886847.3
2	826949.9
3	837479.1
4	974869.4
5	538818.8
6	165972.7
7	79821.2
8	1807.8
9	22908.8

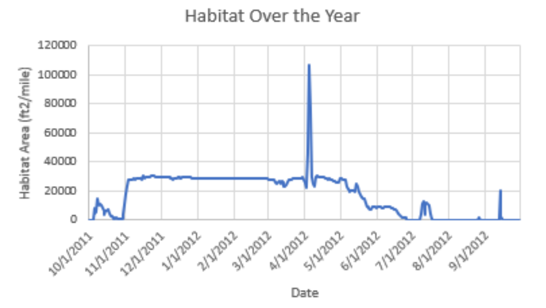
Lifestage Time Period	Total Habitat (ft^2/mile)
Larvae (5-6)	704791.5
Juvenile (7-9)	104537.8
Adult (10-4)	5411307.3
Adult Entire Year	6220636.7

Moving Average	
Month	Total Habitat (ft^2/mile)
10	115756.9
11	774913.7
12	904925.7
5	593101.6
6	191018.4
7	80298.8
8	1549.5
9	23167.1

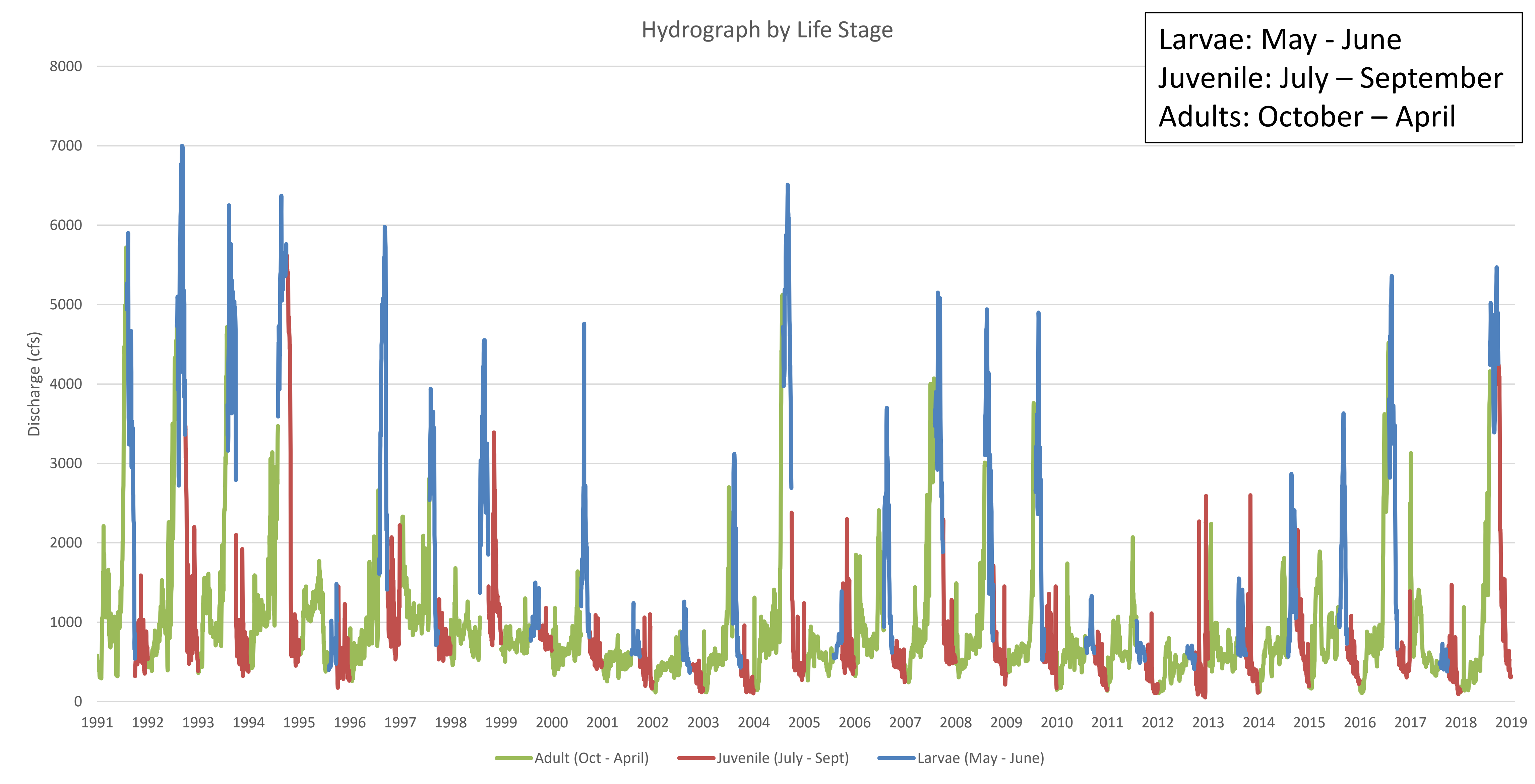
Average habitat over life stage months

Lifestage Time Period	Total Habitat (ft^2/mile)
Larvae (5-6)	784120.0
Juvenile (7-9)	105015.5
Adult (10-4)	5328625.0
Adult Entire Year	6217760.4

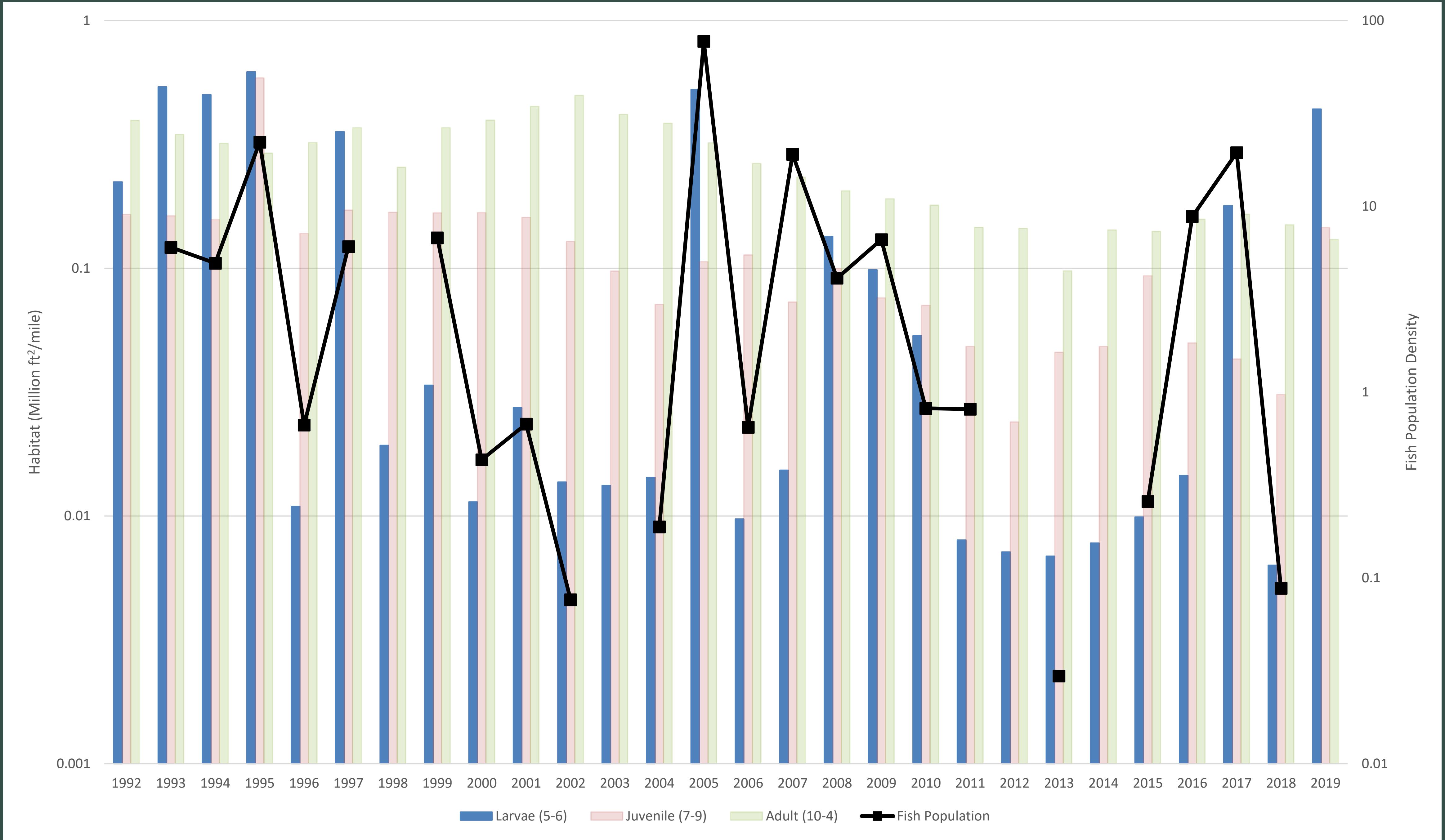




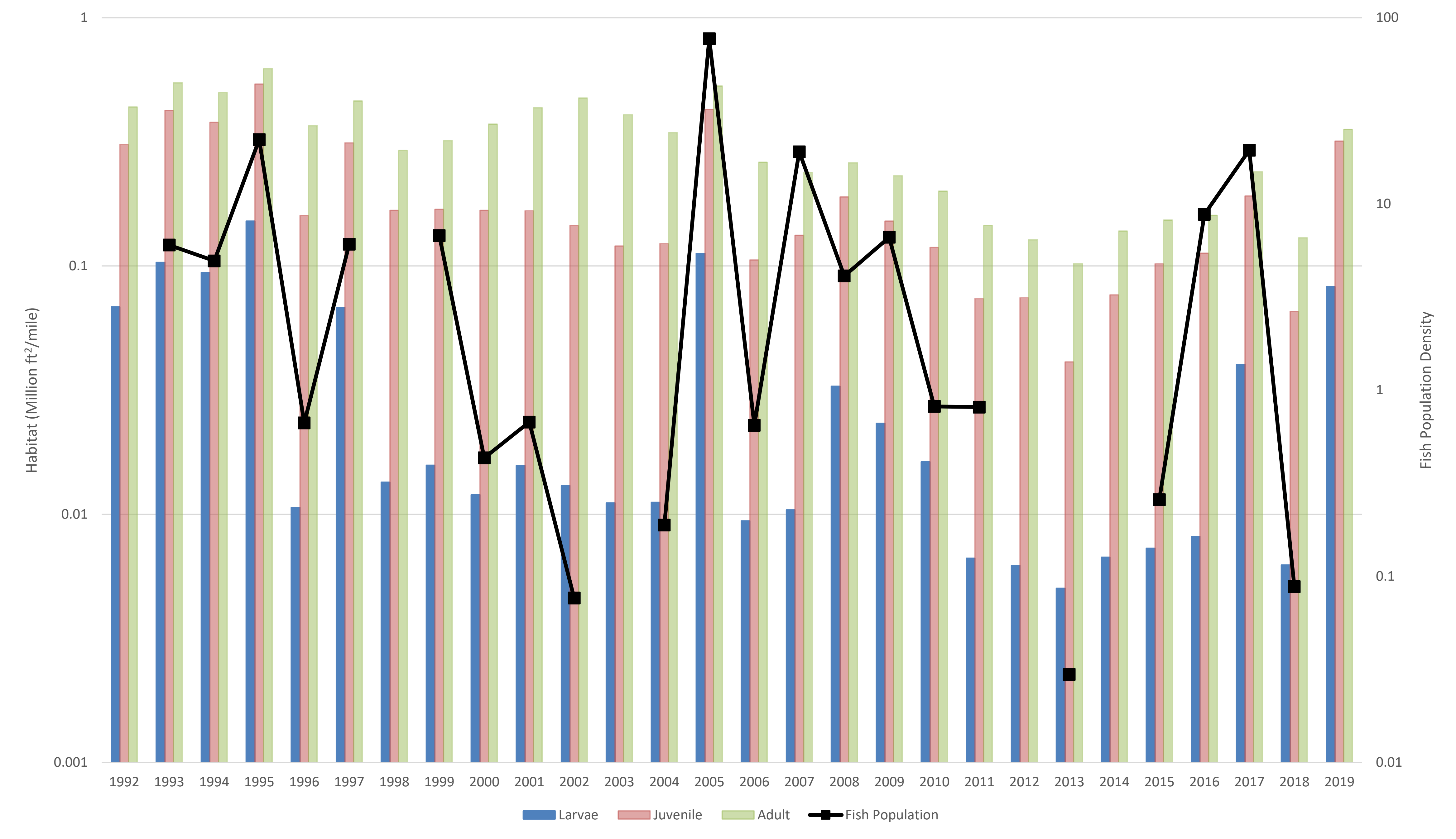
Rio Grande at Albuquerque Gage (08330000)



TIHM Results – Representative Sampling Months



TIHMs Results – Life Stage Over Entire Year



Contents

Conclusions

- For all Isleta sub-reaches, earlier years (1962 and 1972) showed distinct geomorphic stage 1 patterns, while years 1992 - 2012 shifted to geomorphic stages 3 - M8. For Rio Puerco sub-reaches, we see earlier shifts in geomorphic stage than Isleta.
- Stages 1-3 tend to have “round” habitat curves while other stages tend to have “step” and ‘hook” habitat curves above bankfull discharge.
- For RGSM habitat restoration potential, the best sub-reaches are I1-I3 and P1/P2.
  - These sub-reaches have disconnected areas close to the main channel that could be re-connected to increase habitat.
- The larvae TIHM seems to correlate well with the RGSM population density.

Contents

Future Recommendations/Limitations

- For 1-D modeling, more LIDAR data will be needed (approximately every 10 years and same year as Agg-deg surveys) to map the RGSM habitat. This would better describe changes in habitat and restoration potential.

- Manning's n can significantly change velocity, and thus habitat results; therefore, accurate Manning's n on floodplains are desirable.

- 2-D modeling is recommended for areas with better habitat restoration potential.
  - 1-D models do not account for flow distribution between cross-sections and do not always accurately predict the amount of water in the main channel vs floodplain (USBR, 2020).

Thank you!