ENVIRONMENTAL FLOW ANALYSIS FOR RIO GRANDE SILVERY MINNOW RECRUITMENT

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ESTRESSED CONCRET





File Name

Environmental Flow

"The goal of environmental flow management is to restore and maintain the socially-valued benefits of healthy, resilient freshwater ecosystems through participatory decision-making informed by sound science."

THE BRISBANE DECLARATION (2007)

http://riverfoundation.org.au/wp-content/uploads/2017/02/THE-BRISBANE-DECLARATION.pdf





Environmental Flow

management for endangered fish species focuses on a resilient freshwater ecosystems







Recruitment Flow



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Functional analysis

Evaluates the relationships of fish and environmental metrics

Linear models in R software

- Higher correlation (**r**²) with smaller **AIC** score
- Evaluate the ecological and biological relevance of metric interactions







Fish Metrics

Fish metrics were derived from population monitoring data

- Recruitment slope reproductive success from May through July
- October Index fish population at the end of irrigation season
- P = fish population/unit area; T= date range

Fish Metric	Formula	Date
Recruit Slope	lm(log_10 (P ~ T))	May 1 - Aug 9
October Index	100P+0.001	October

Correlation of fish metrics (r ²)	October Index	Geomean slope	YOY CPUE	Egg Abundance	Egg Occurrence	Eggs Present
Recruit slope	0.680	0.789	0.830	0.064	0.000	0.000
October Index		0.771	0.953	0.034	0.042	0.091
Geomean slope			0.787	0.062	0.044	0.011
YOY CPUE				0.053	0.008	0.034







Fish metrics

7

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Hydrological flow metrics







Hydrological flow metrics

Recruitment slope	r ²	AIC	October Index (CPUE)	r ²	AIC
21-day Maximum-minimum flow	0.90	-16.09	21-day Maximum-minimum flow	0.68	101.06
Cumulative flow volume May-June at Albuquerque	0.89	-14.67	14-day Maximum-minimum flow	0.67	101.62
14-day Mean-minimum flow	0.89	-14.67	Cumulative flow volume May-June at Albuquerque	0.66	102.15
14-day Maximum-minimum flow	0.88	-14.32	14-day Mean-minimum flow	0.65	102.51
21-day Mean-minimum flow	0.88	-14.19	7-day Mean-minimum flow	0.65	102.73
7-day Mean-minimum flow	0.88	-13.72	21-day Mean-minimum flow	0.64	102.88
Cumulative flow volume April-June at Albuquerque	0.86	-11.67	1-day Maximum-minimum flow	0.64	102.93
3000 cfs Exceedence at Albuquerque	0.85	-10.48	3000 cfs Exceedence at Albuquerque	0.63	103.63
Cumulative flow volume May-July at Albuquerque	0.85	-9.93	Cumulative flow volume April-June at Albuquerque	0.62	103.99
7-day Maximum-minimum flow	0.83	-8.48	Cumulative flow volume May-July at Albuquerque	0.61	104.07
2000 cfs Exceedence at Albuquerque	0.83	-8.44	7-day Maximum-minimum flow	0.60	104.56
1-day Maximum-minimum flow	0.78	-4.88	2000 cfs Exceedence at Albuquerque	0.55	106.41





Larval minnow habitat suitability







Hydraulic habitat area metrics

Recruitment slope	r ²	AIC	October Index (CPUE)	r² /	AIC
1D Total Surface Area (10-mile study area)	0.96	-29.73	Overbank Surface Area (regional study area)	0.84	90.63
Overbank and Velocity Criteria (Larval) 1D (10-mile study area)	0.95	-25.63	1D Total Surface Area (10-mile study area)	0.82	93.00
Overbank Surface Area (regional study area)	0.94	-25.37	Annual Overbank Surface Area (10-mile study area)	0.80	94.53
Annual Overbank Surface Area (10-mile study area)	0.94	-25.17	Overbank and Velocity Criteria (Larval) 1D (10-mile study area)	0.79	95.29
Overbank and Depth Criteria (Larval) 1D (regional study area)	0.94	-23.07	21-Day 1D Mean-Minimum (HSI acres)	0.78	95.72
Overbank and Depth Criteria (Larval) 1D (10-mile study area)	0.92	-20.41	14-Day 1D Mean-Minimum (HSI acres)	0.74	98.04
14-Day 1D Mean-Minimum (HSI acres)	0.89	-15.22	Overbank and Depth Criteria (Larval) 1D (regional study area)	0.73	98.72
21-Day 1D Maximum-minimum (acres)	0.89	-15.00	7-Day 1D Mean-Minimum (HSI acres)	0.70	100.25
21-Day 1D Mean-Minimum (HSI acres)	0.89	-14.69	Overbank and Depth Criteria (Larval) 1D (10-mile study area)	0.70	100.41
Overbank and Velocity Criteria (Larval) 1D (regional study area)	0.89	-14.64	Overbank and Velocity Criteria (Larval) 1D (regional study area)	0.63	103.48
7-Day 1D Mean-Minimum (HSI acres)	0.87	-12.87	Overbank Surface Area (10-mile study area)	0.58	105.25
14-Day 1D Maximum-minimum (acres)	0.83	-8.67	14-Day 1D Maximum-minimum (acres)	0.57	105.58

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Functional analysis suggests the 14-21 day maximumminimum flow is important for silvery minnow production

Environmental flow (Spring runoff)	21-day maximum- minimum flow range		14-day maximum- minimum flow range		Recruitment (slope)		October Index (CPUE)	
	Min	Max	Min	Max	Min	Max	Min	Max
Good flow	2460	5610	2630	5780	0.26	1.15	0.42	36.83
Threshold flow	1130	1870	1400	2100	0.06	0.07	0.15	0.79
Poor flow	426	759	499	1040	0.00	0.07	0.01	0.55





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QUESTIONS?

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