

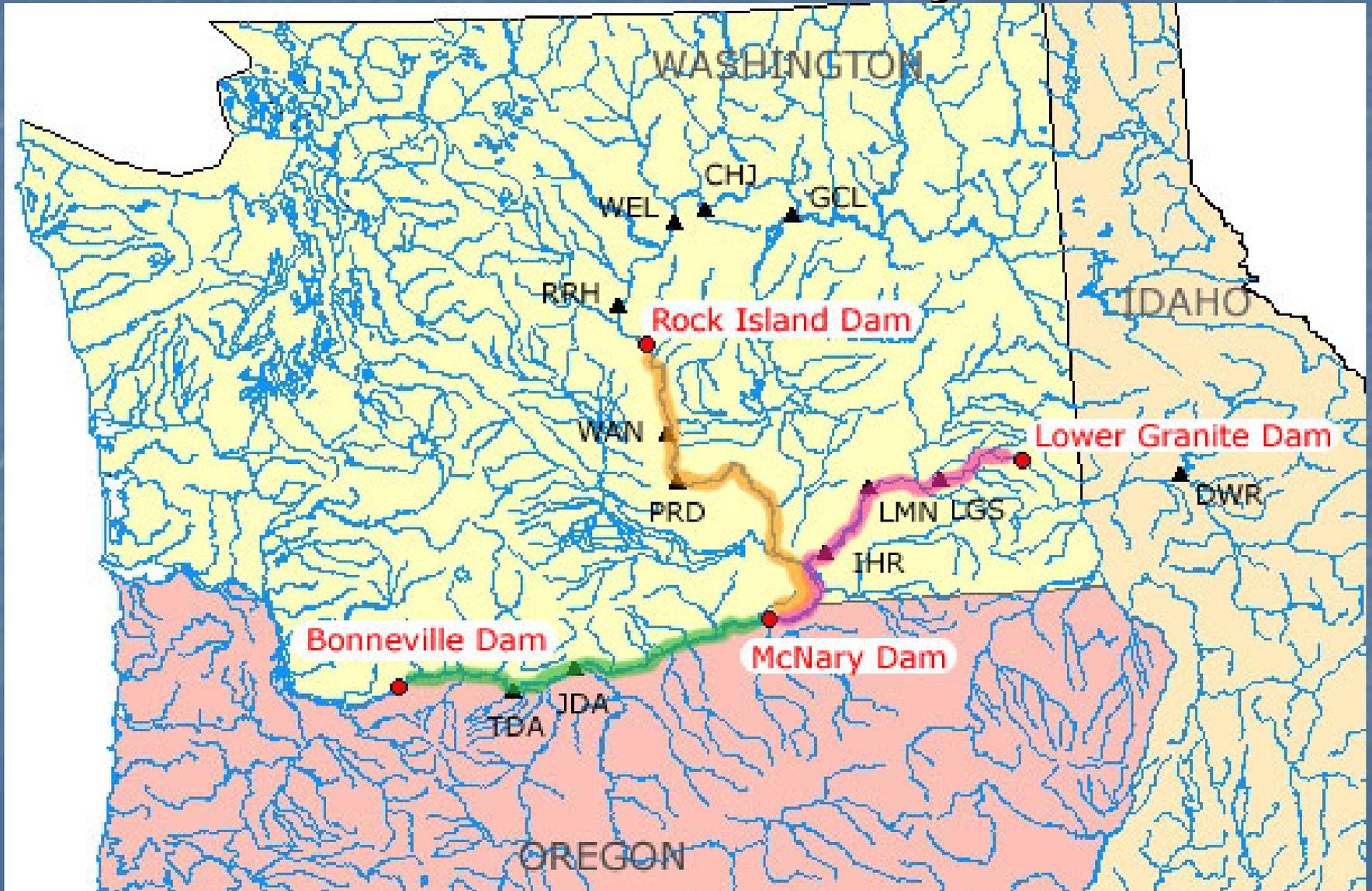
Yearling Chinook and Steelhead
Survival Lower Granite to McNary
Dam 1998 to 2008
(preliminary results)

Fish Passage Center

Overview

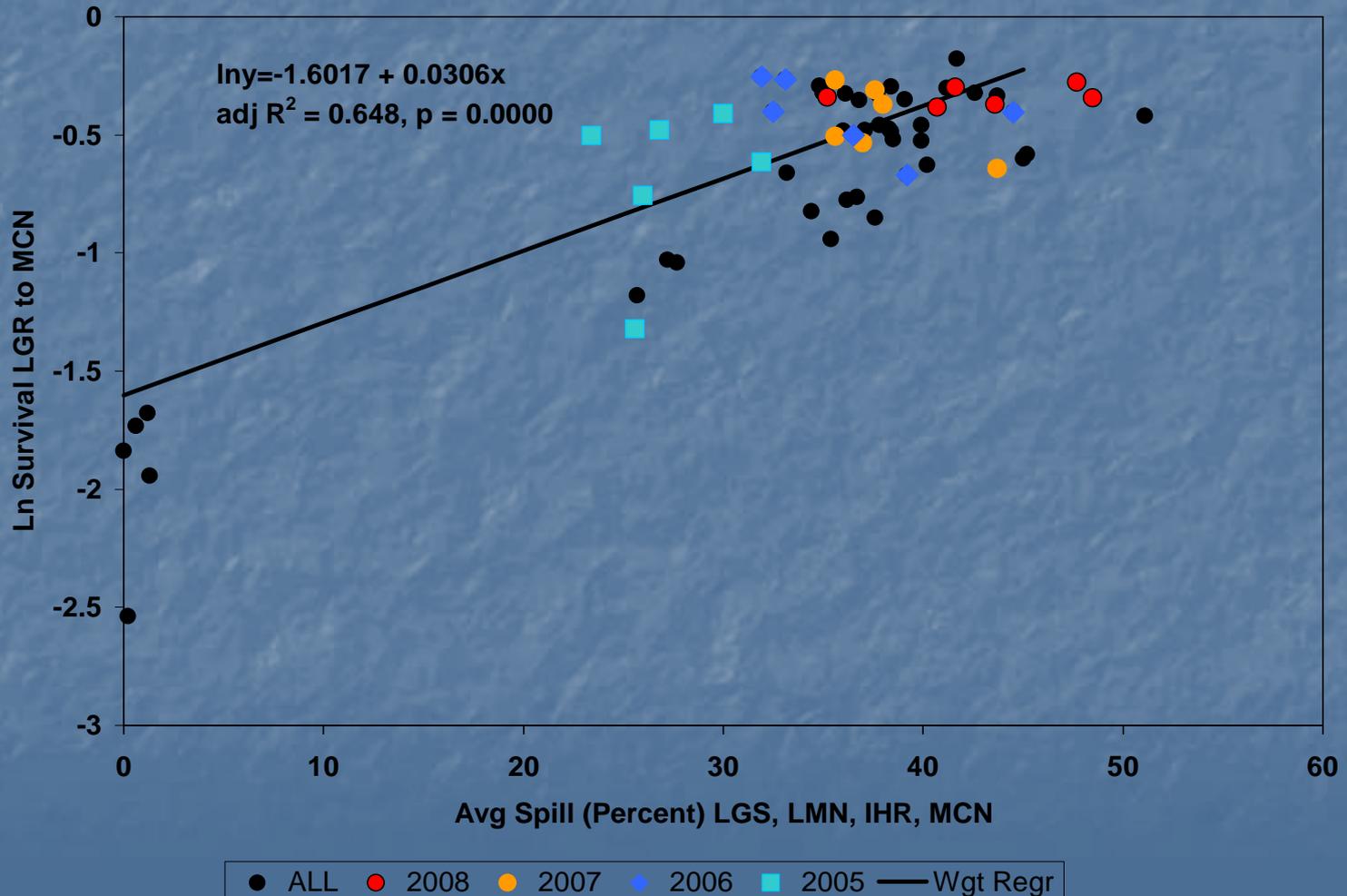
- PIT-tagged steelhead and wild yearling Chinook passing LGR dam during one-week cohorts from April to June each year (6 sthd 8 ch1 cohorts per year)
- Estimate Survival and Travel Time for cohorts
- Assign average environmental variables during passage such as Flow, Spill, Temperature and Water Transit Time
- Show bivariate plots of Reach Survival and environmental variables.
- Show results of multi-model regression
- Estimates of transport proportions

Lower Granite to McNary Dam Reach



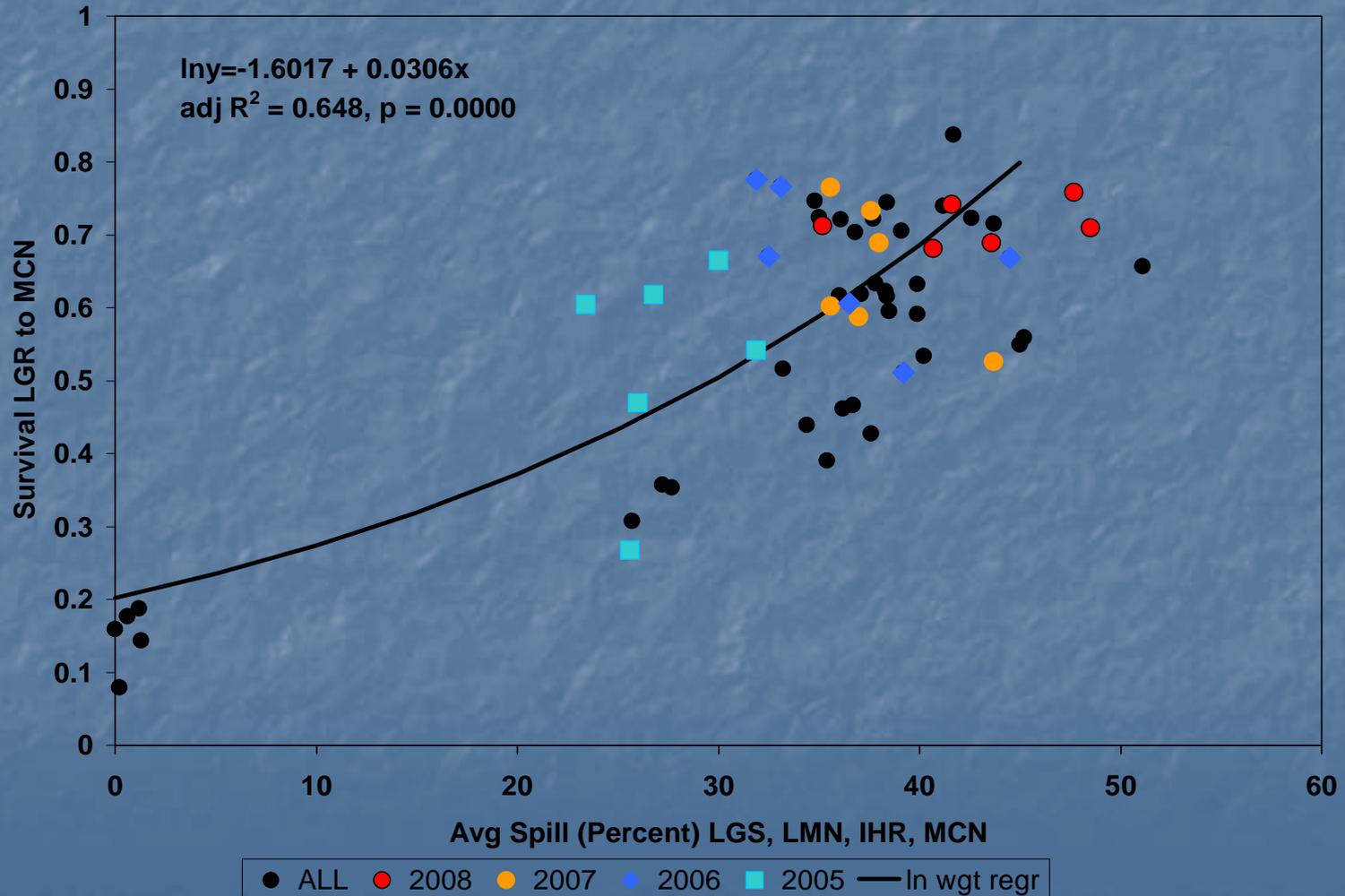
Steelhead InSurvival vs Avg Spill

Pct LGS, LMN, IHR, MCN



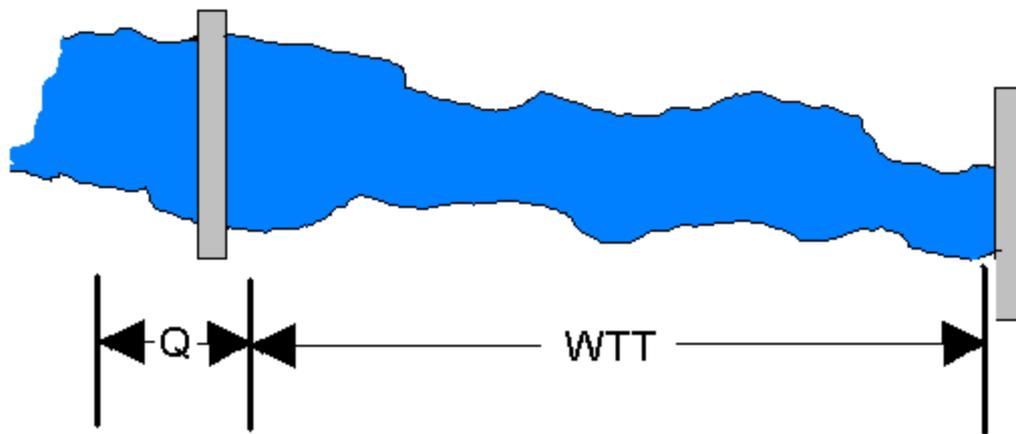
Steelhead Survival vs Avg Spill Pct

LGS, LMN, IHR, McN

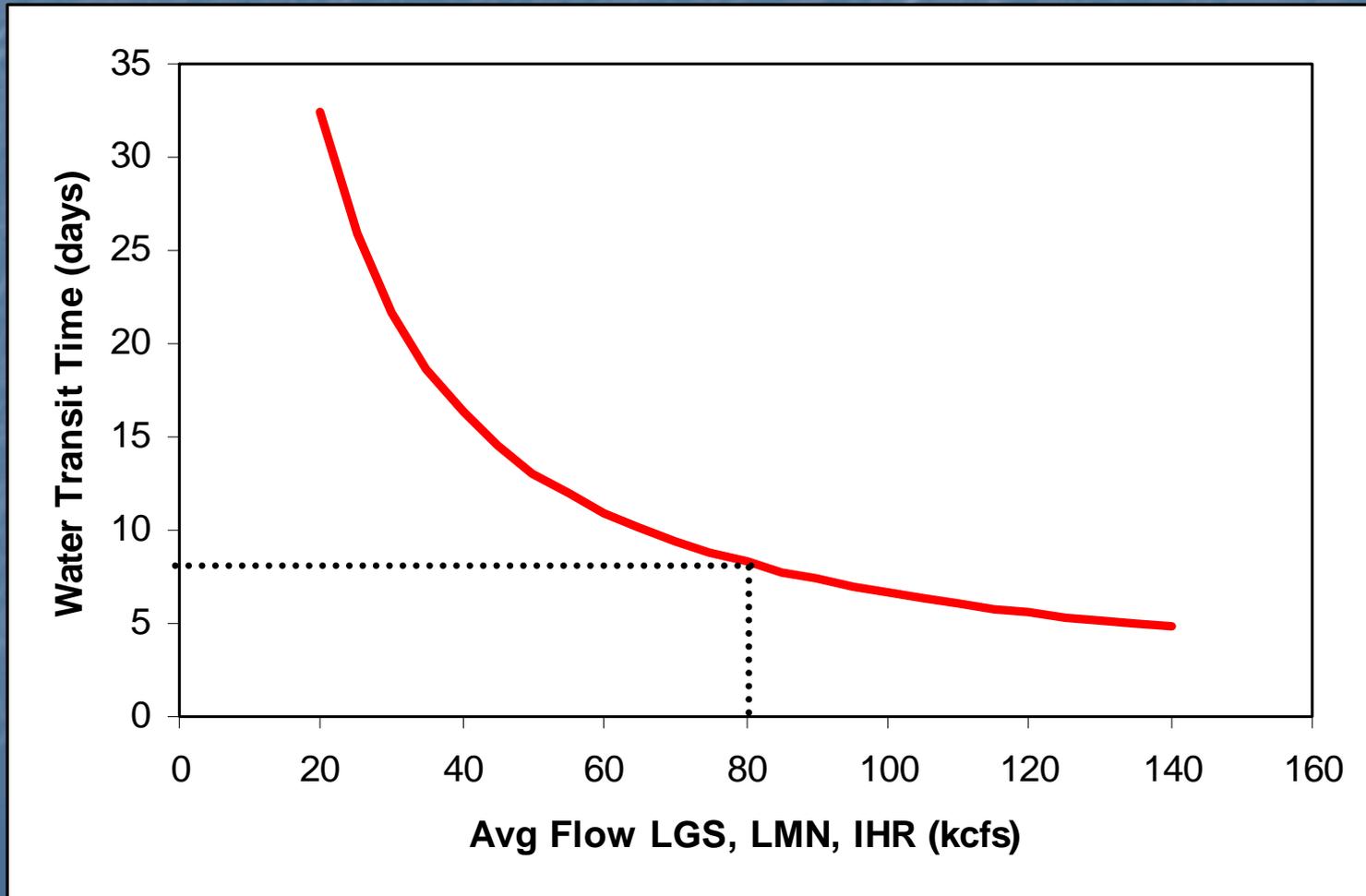


Water Transit Time

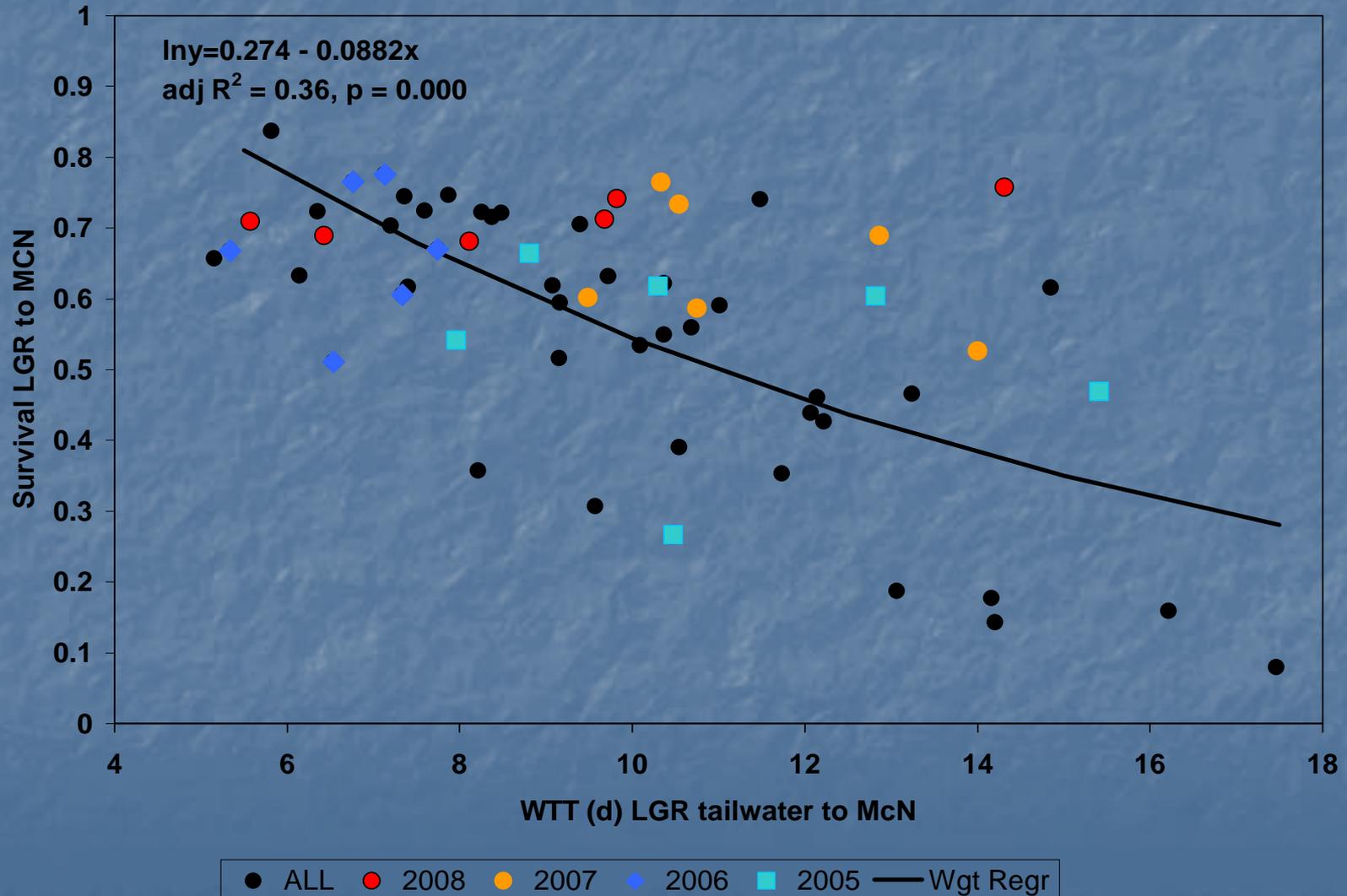
- WTT--Avg Time for Water Particle to Transit Reservoir
- Q -- discharge at dam



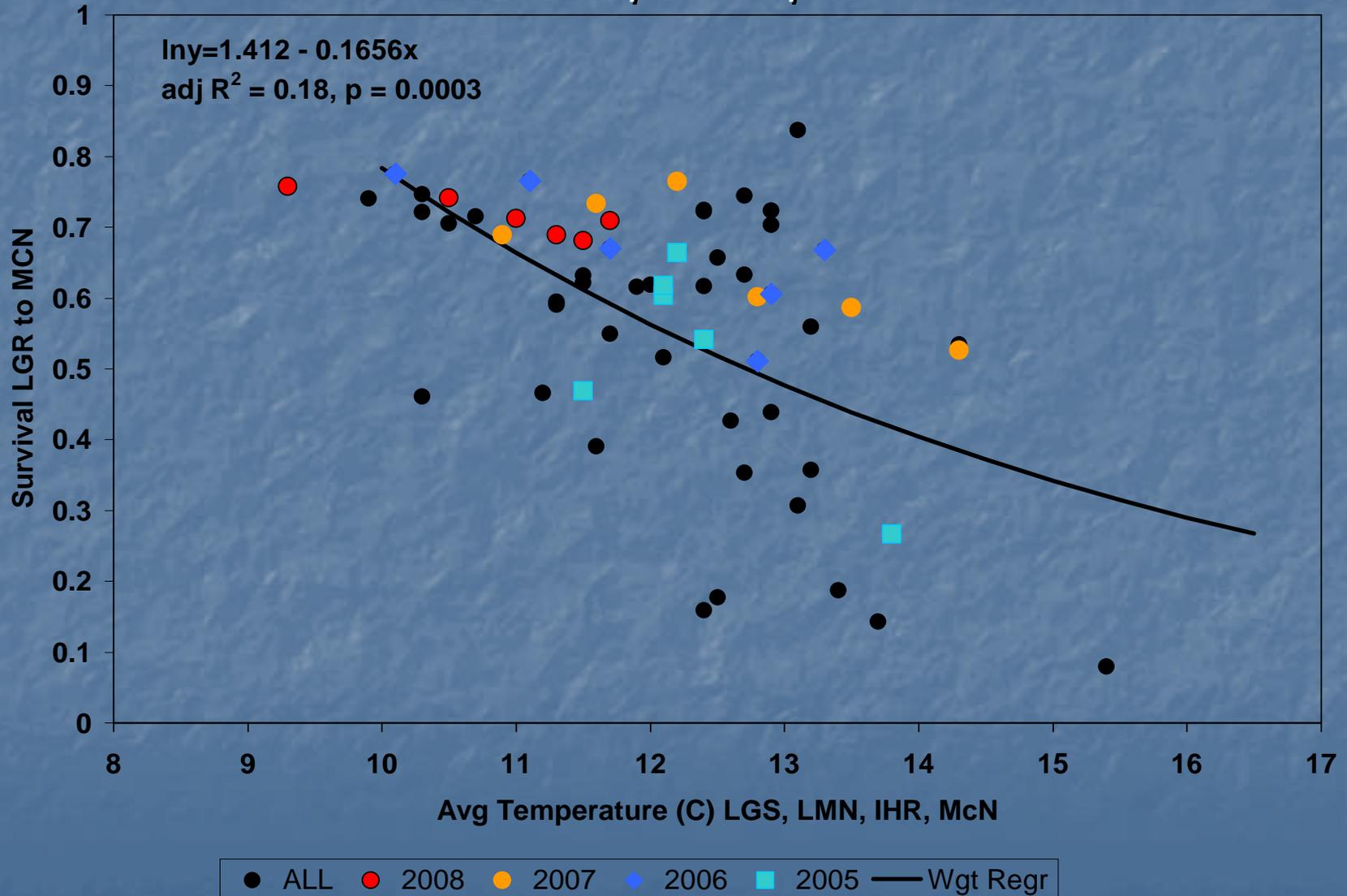
Converting Flows to Water Transit Time



Steelhead Survival vs sum WTT LGS, LMN, IHR, McN



Steelhead Survival vs Avg Temp LGS, LMN, IHR, McN



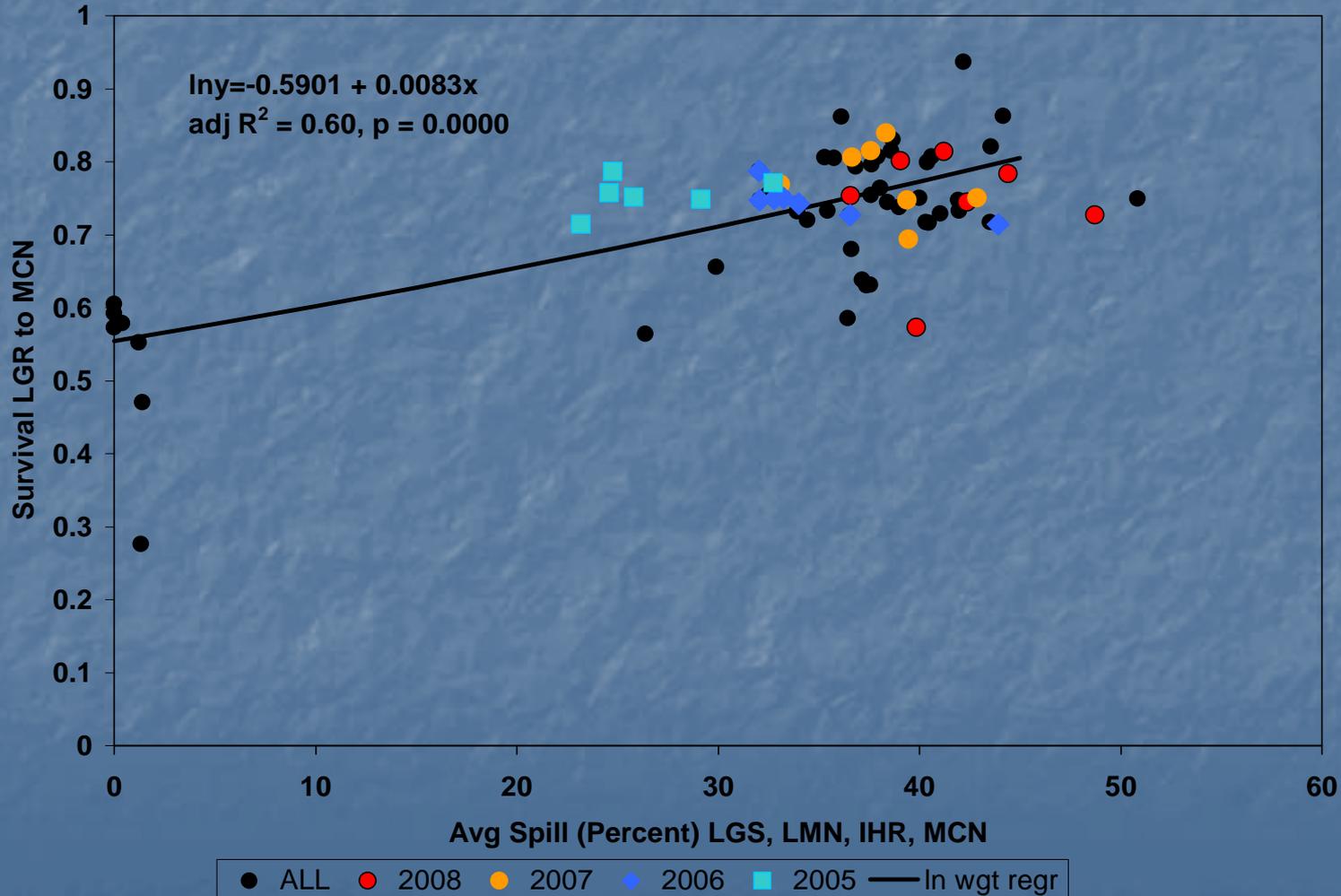
Results of multi-model analysis for Steelhead

adj R ²	Model	Variables	AICc	delta AICc	Weight
0.80	AV_SPIL_PROP,WTT,REL_GRP	3	74.8	0.0	0.730
0.80	WTT,REL_GRP,AV_TEMPC,AV_SPIL_PROP	4	76.8	2.0	0.268
0.76	AV_SPIL_PROP,WTT,AV_TEMPC	3	86.2	11.4	0.002
0.70	AV_TEMPC,AV_SPIL_PROP	2	97.6	22.7	0.000
0.70	AV_SPIL_PROP,REL_GRP	2	98.1	23.2	0.000
0.70	REL_GRP,AV_TEMPC,AV_SPIL_PROP	3	98.4	23.6	0.000
0.68	AV_SPIL_PROP,WTT	2	102.2	27.3	0.000
0.65	AV_SPIL_PROP	1	106.5	31.7	0.000
0.57	WTT,REL_GRP,AV_TEMPC	3	121.2	46.4	0.000
0.56	WTT,AV_TEMPC	2	121.4	46.6	0.000
0.54	WTT,REL_GRP	2	124.6	49.8	0.000
0.36	WTT	1	143.1	68.3	0.000
0.22	REL_GRP,AV_TEMPC	2	156.0	81.2	0.000
0.18	AV_TEMPC	1	157.8	82.9	0.000
0.00	REL_GRP	1	170.0	95.2	0.000

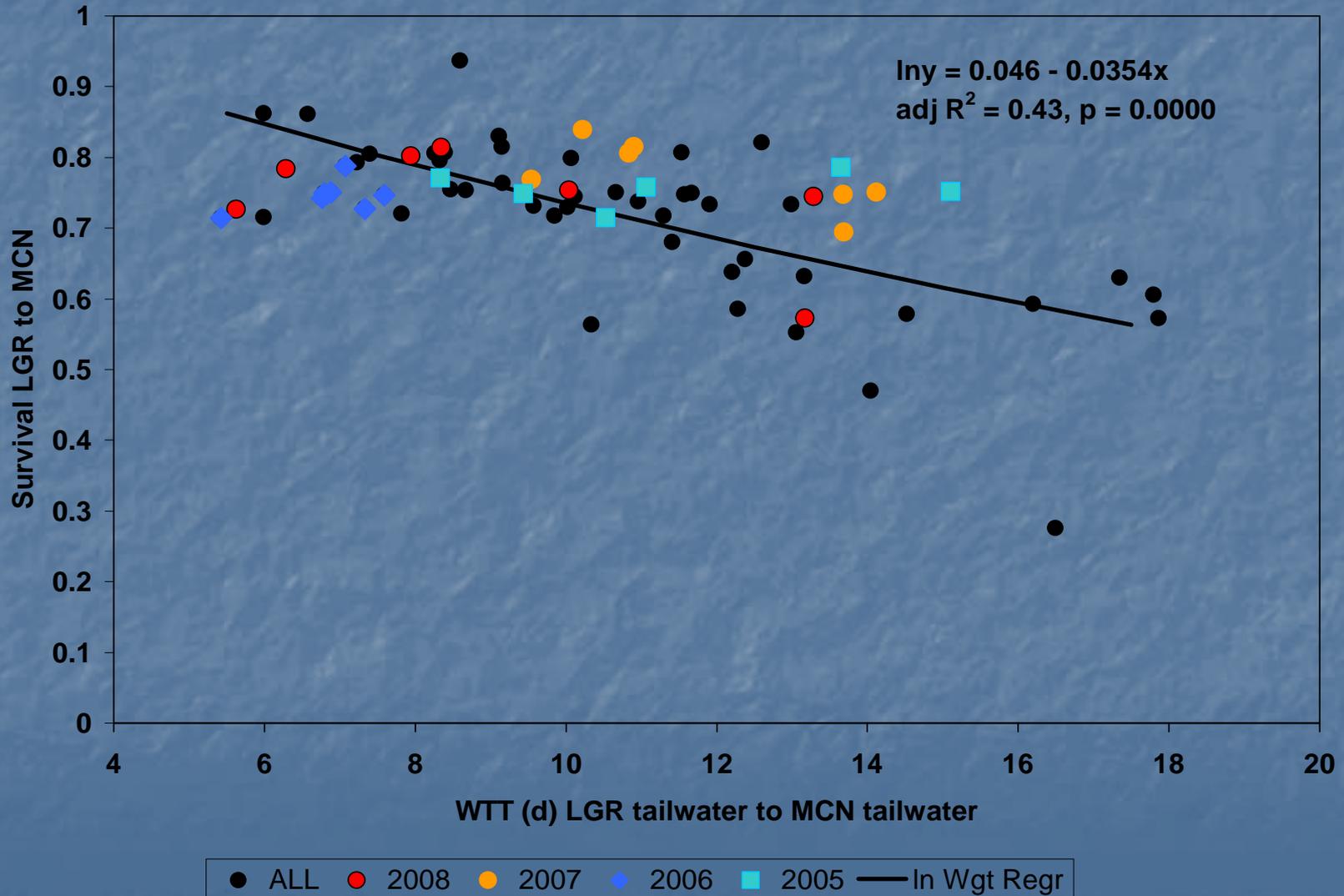
Relative Variable Importance (weight of evidence) HWST

Variable	RVI
AV_SPIL_PROP	1.00
WTT	1.00
AV_TEMPC	0.27
REL_GRP	1.00

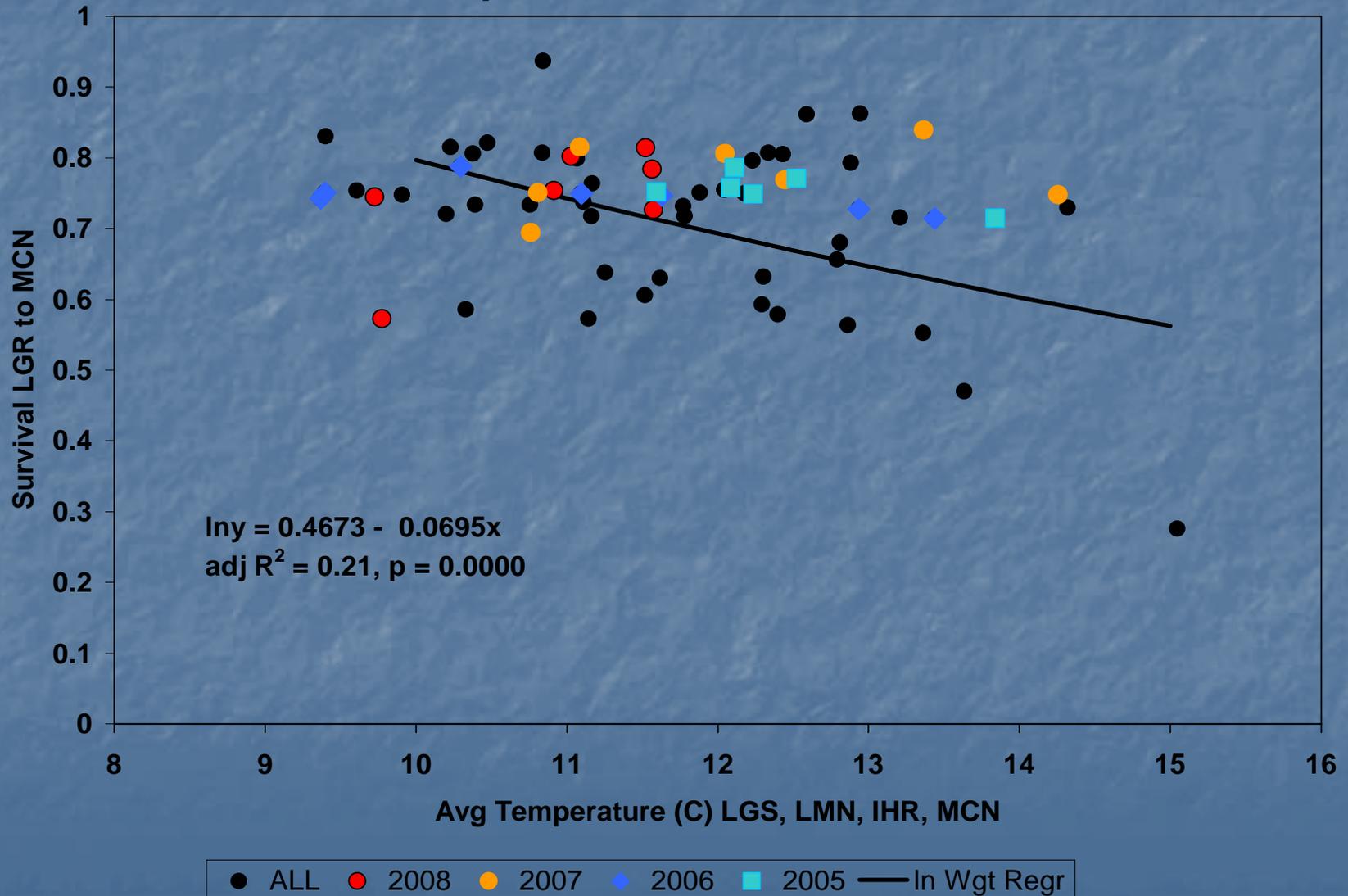
Wild Yearling Chinook Survival vs Avg Spill Pct LGS, LMN, IHR, McN



Wild Yearling Chinook Survival vs sum WTT LGS, LMN, IHR, McN



Wild Yearling Chinook Survival vs Avg Temp LGS, LMN, IHR, McN



Results of multi-model analysis for yearling Chinook

adj R ²	Model	Variables	AICc	Delta AICc	Weight
0.66	AV_SPIL_PROP,WTT,AV_TEMPC	3	55.4	0	0.384
0.66	REL_GRP,AV_SPIL_PROP,WTT	3	55.6	0.2	0.350
0.66	REL_GRP,AV_SPIL_PROP,WTT,AV_TEMP	4	56.8	1.4	0.190
0.64	AV_SPIL_PROP,WTT	2	59.0	3.6	0.063
0.61	AV_TEMPC,AV_SPIL_PROP	2	63.7	8.3	0.006
0.60	AV_SPIL_PROP	1	64.2	8.9	0.005
0.61	AV_TEMPC,REL_GRP,AV_SPIL_PROP	3	66.0	10.7	0.002
0.55	WTT,AV_TEMPC,REL_GRP,	3	75.3	19.9	0.000
0.50	REL_GRP,WTT	3	80.9	25.5	0.000
0.43	WTT	1	88.5	33.1	0.000
0.26	REL_GRP,AV_TEMPC	2	109.2	53.8	0.000
0.21	AV_TEMPC	1	111.7	56.4	0.000
0.00	REL_GRP	2	128.6	73.2	0.000

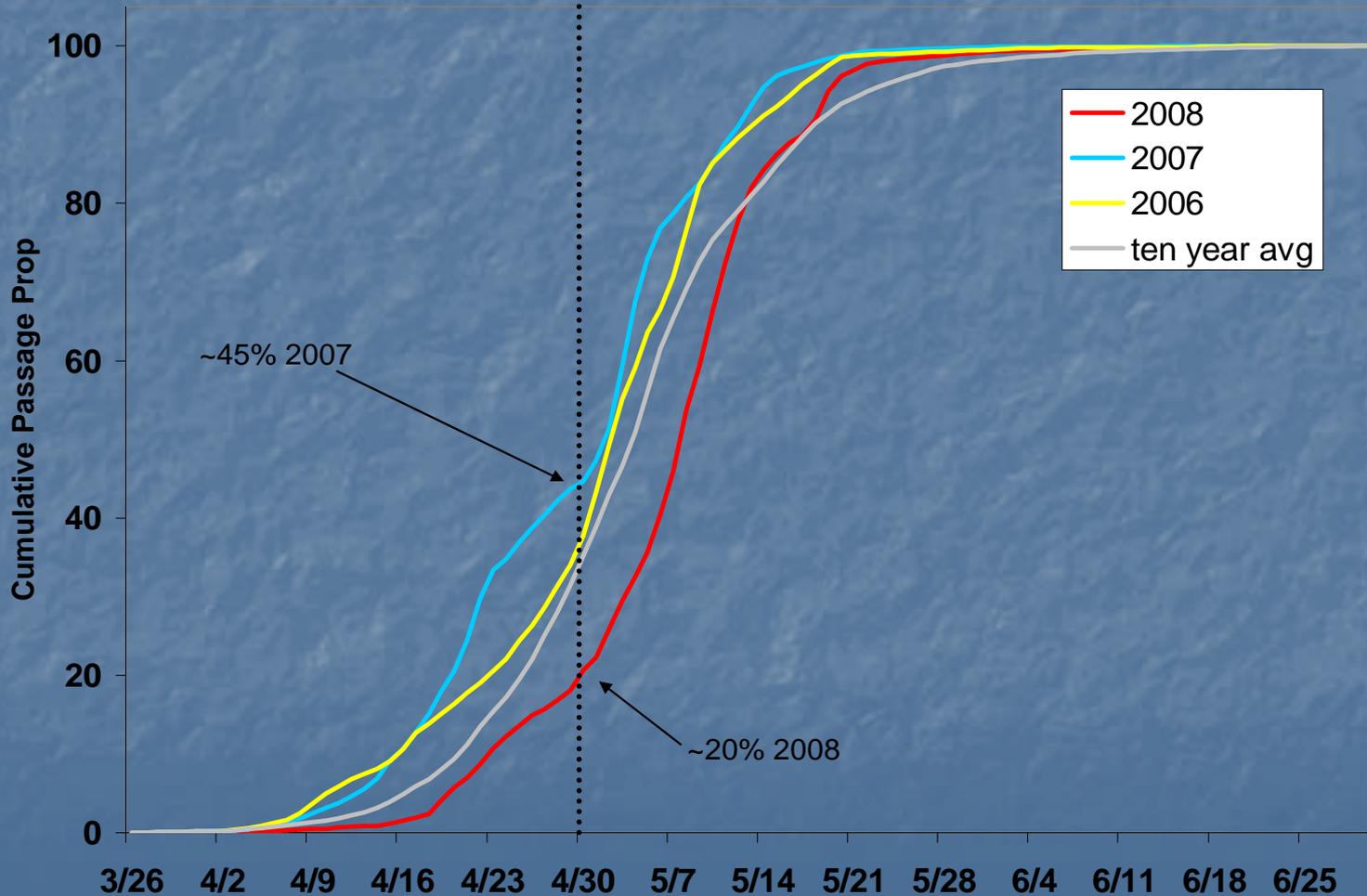
Relative Variable Importance (weight of evidence) CH1W

Variable	RVI
AV_SPIL_PROP	1.00
WTT	0.99
AV_TEMPC	0.58
REL_GRP	0.54

Probability of being transported

Salmonid Group	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Chinook Yearlings	0.79	0.71	0.99	0.68	0.63	0.87	0.92	0.58 (W) 0.61 (H)	0.29 (W) 0.26 (H)	0.49 (W) 0.49 (H)
Steelhead	0.83	0.81	0.99	0.68	0.67	0.96	0.94	0.79(W) 0.76 (H)	0.43(W) 0.47(H)	0.45(W) 0.41(H)

Combined Yearling Chinook Timing at LGR



Conclusions

- For yearling Chinook and Steelhead, increased spill and decreased water transit time (higher flows) appear to improve survival, while higher temperatures decrease survival
- Survivals were relatively high in 2008 because of high flows, spill and cool temperatures
- Higher transport proportion CH1 in 2008 compared to 2007 was due in part to later timing in 08

Hatchery Subyearling Survival Lower Granite to McNary Dam 1998 to 2008

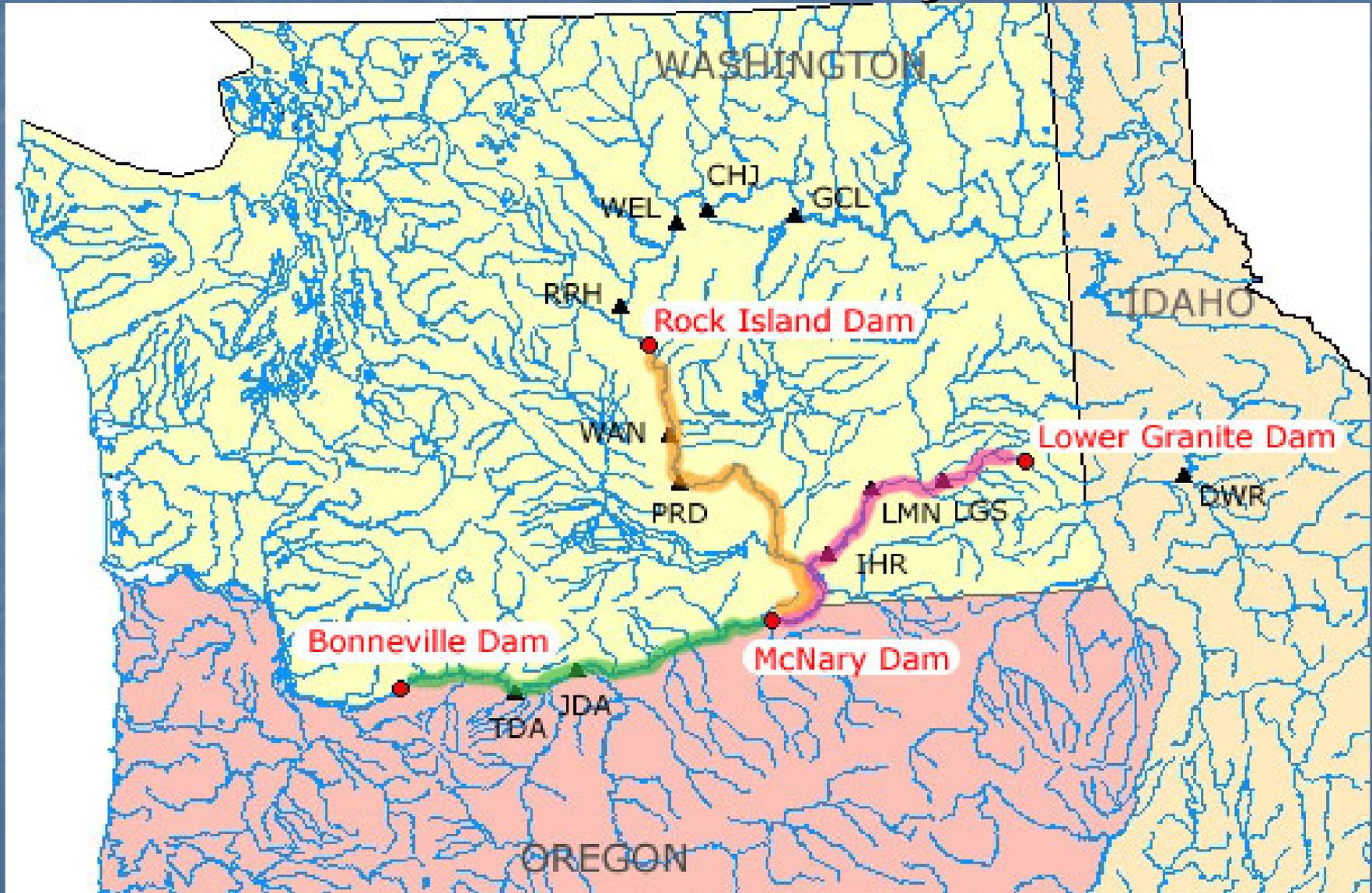
(preliminary results)

Fish Passage Center

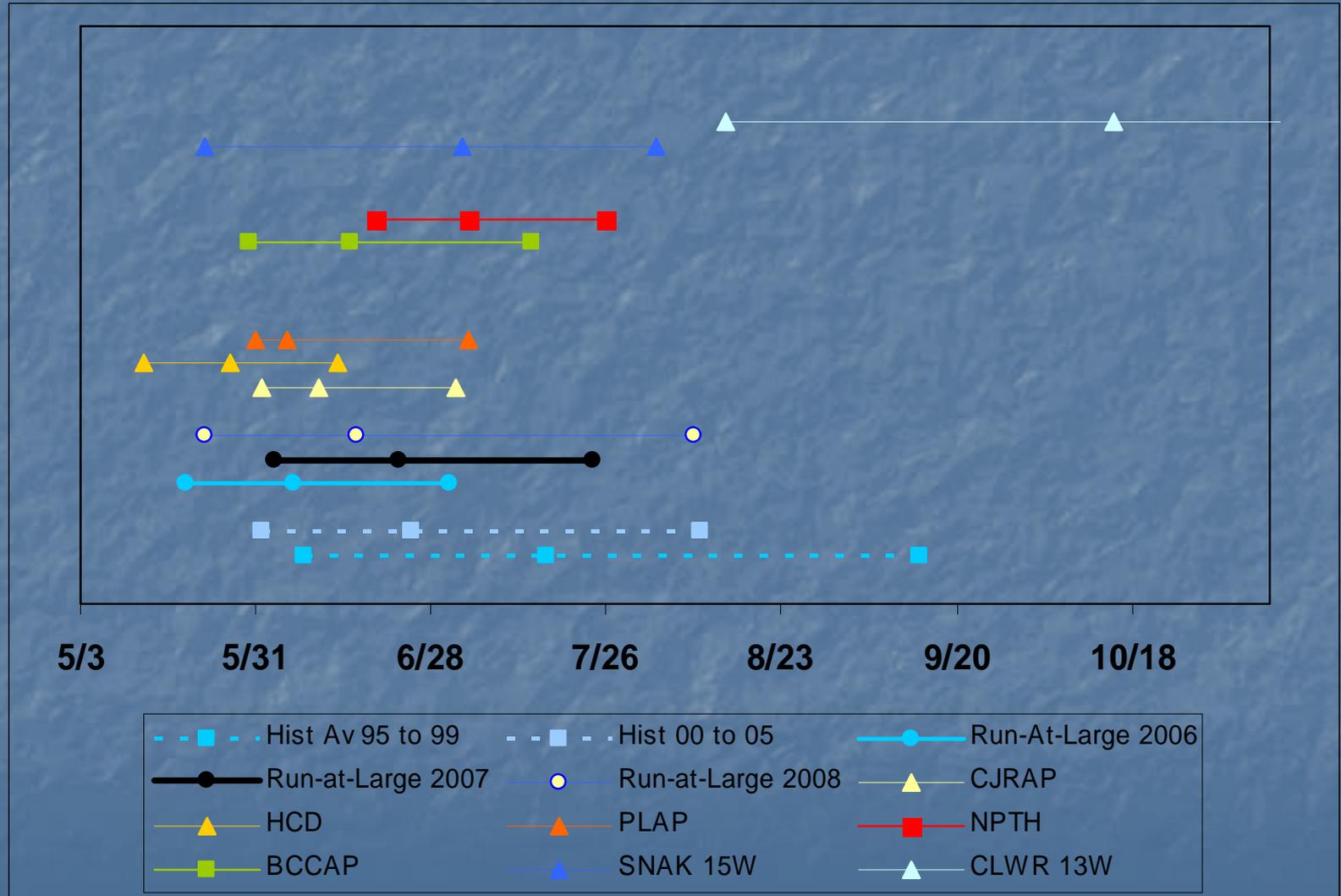
Overview

- PIT-tagged Hatchery Subyearling Chinook passing LGR dam during two-week blocks from May 20 to July 15 each year
- Estimate Survival and Travel Time for blocks
- Assign average environmental variables during passage such as Flow, Spill, Temperature and Water Transit Time
- Show bivariate plots of Reach Survival and environmental variables.

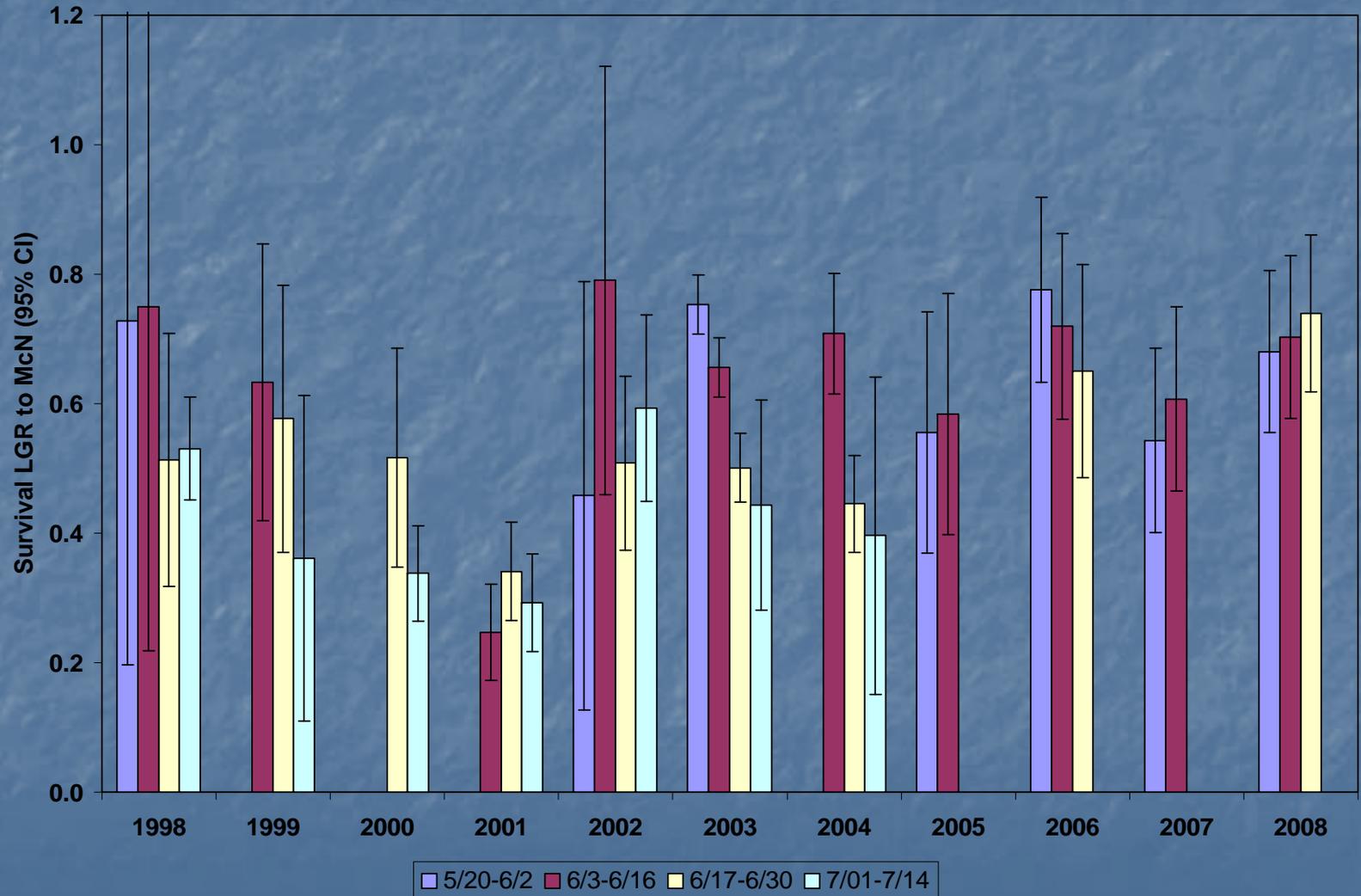
Lower Granite to McNary Dam Reach



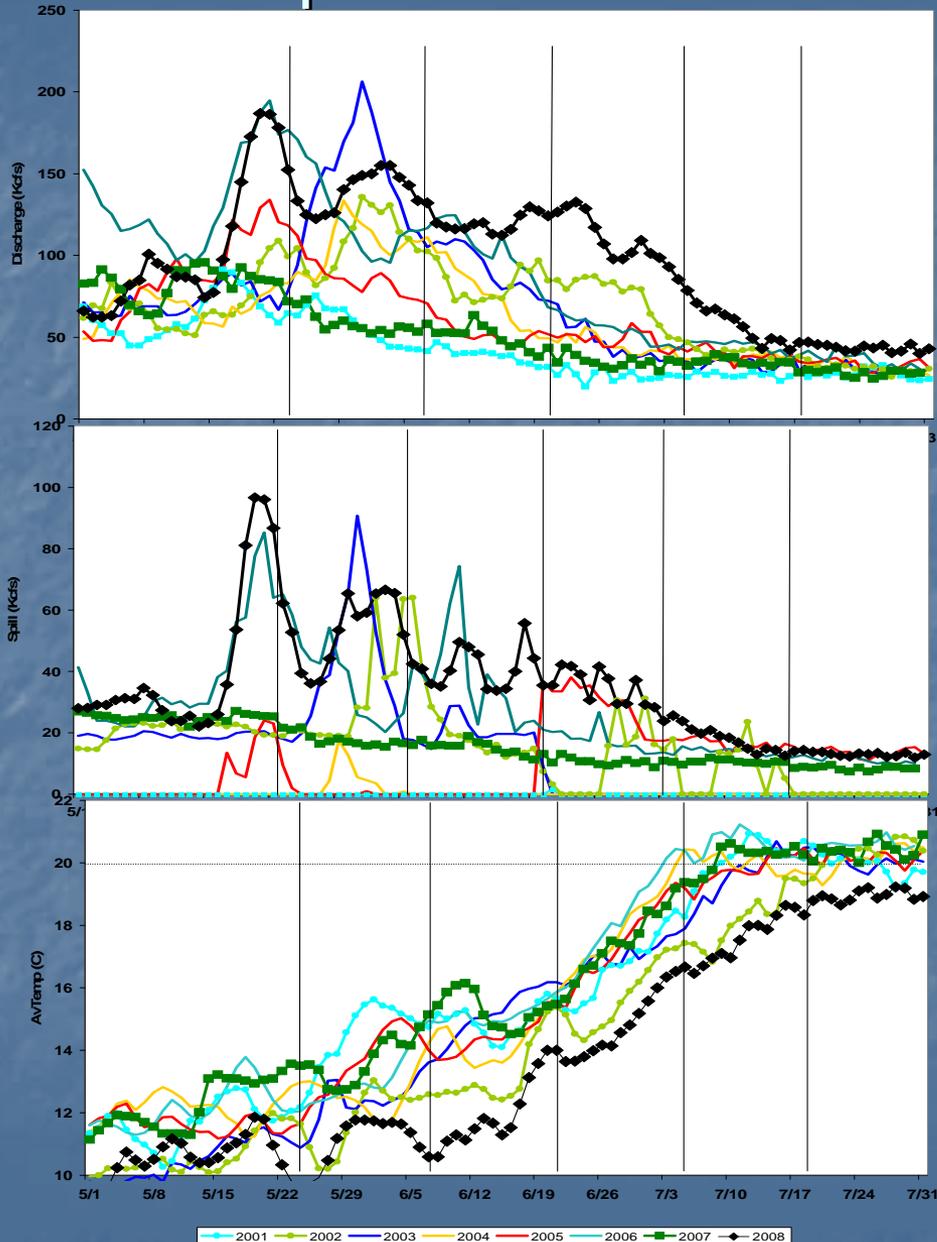
Timing of Subyearling fall Chinook at LGR Dam in 2008 compared to Historic Timing



Survival for Hatchery Subyearling Chinook LGR to McN 1998 to 2008 with 95% CI's



Comparison of Environmental conditions at LGS

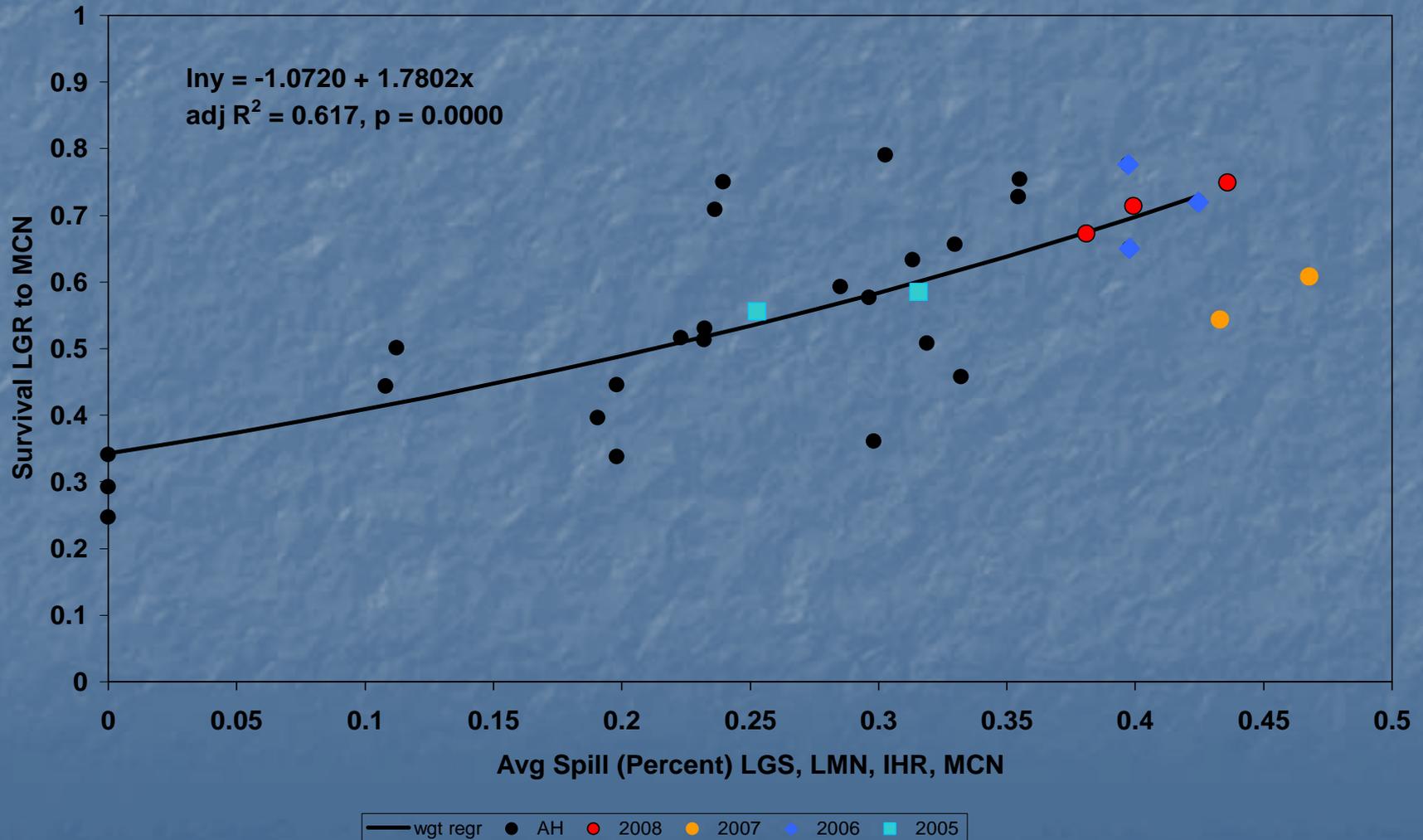


Flows in 2008 were relatively high especially in June and early July

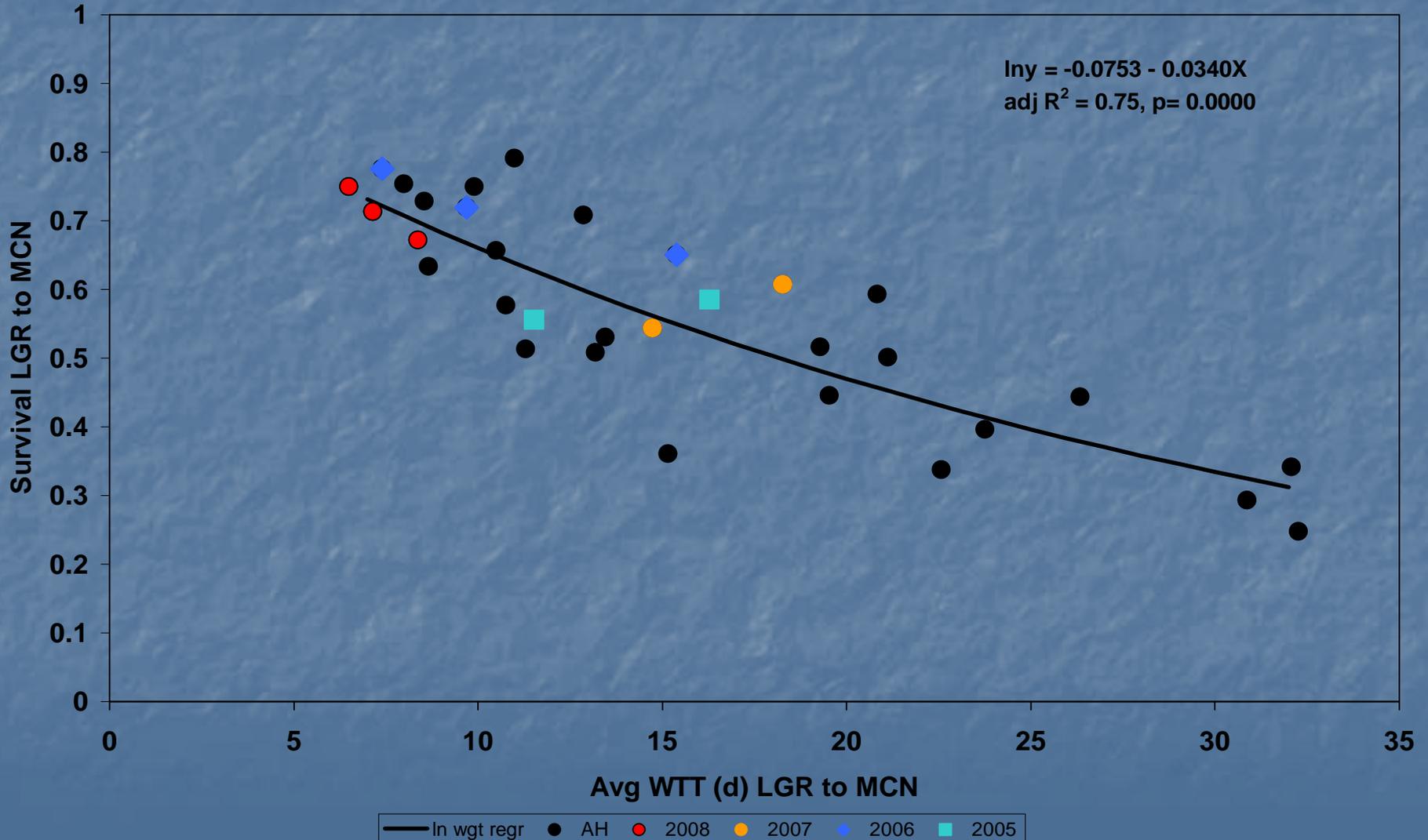
Spill volumes were high in May and average in summer (since 2005)

Temperatures were cool in 2008

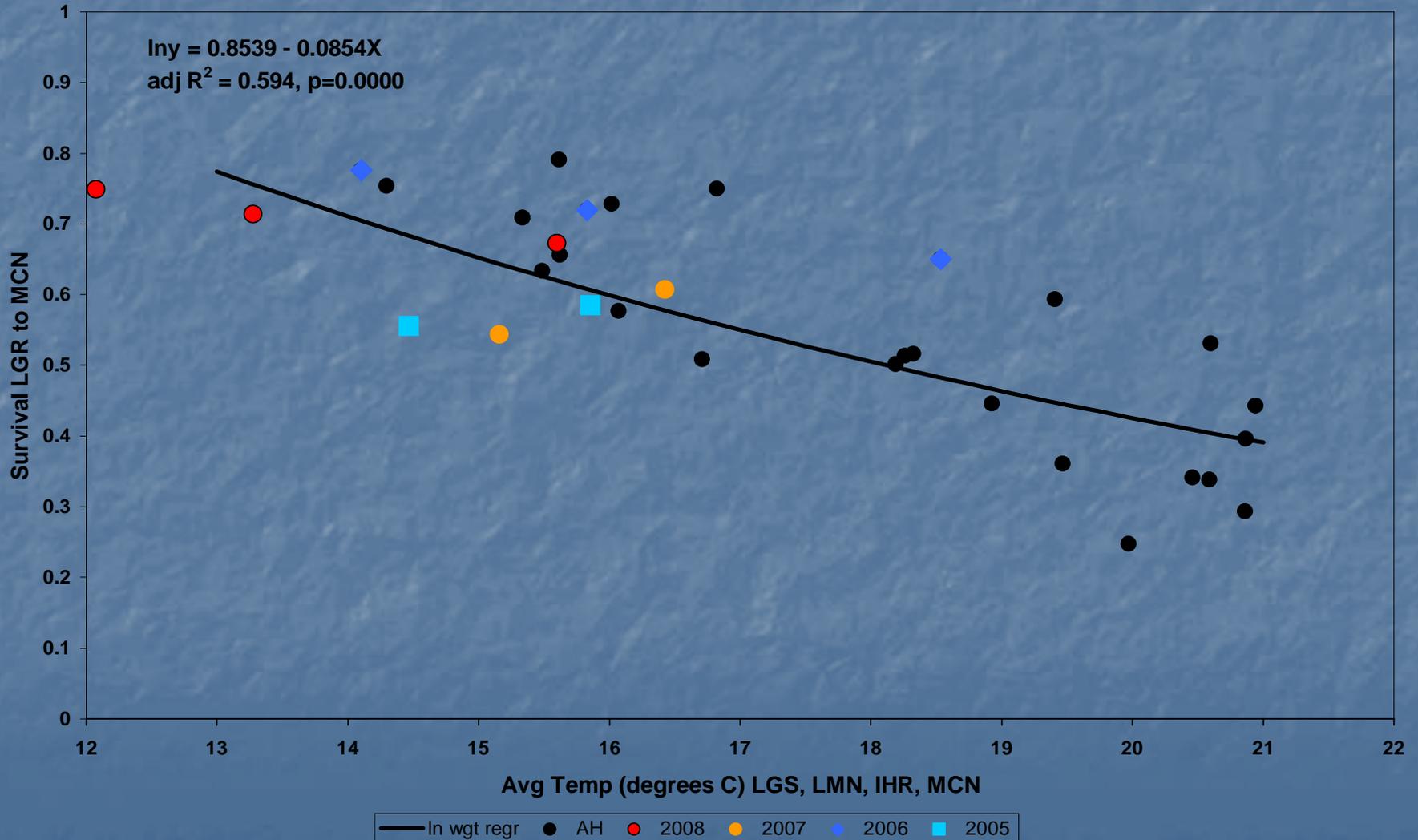
Hatchery Subyearling Chinook Survival vs Avg Spill Pct LGS, LMN, IHR, McN



Hatchery Subyearling Chinook Survival vs sum WTT LGS, LMN, IHR, McN



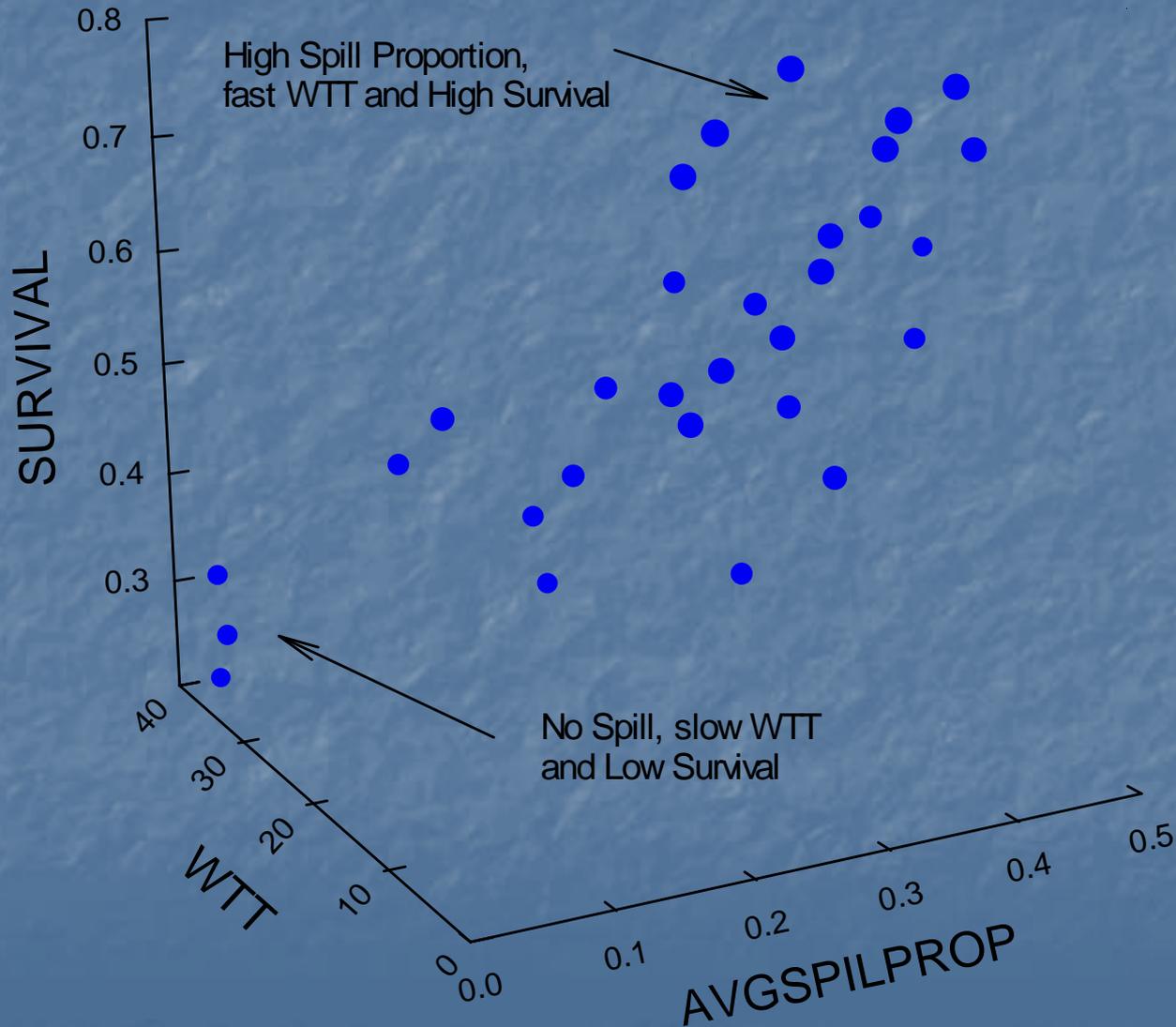
Hatchery Subyearling Chinook Survival vs Avg Temp LGS, LMN, IHR, McN



Pearson Correlation Matrix

	REL_GRP	AV_SPIL_PROP	AV_TEMPC	WTT	FISH TRAVTIME	SURVIVAL
REL_GRP	1.0000					
AVSPILPROP	-0.2291	1.0000				
AV_TEMPC	0.7222	-0.6701	1.0000			
WTT	0.3634	-0.8692	0.7657	1.000		
FISH TRAVTIME	0.3154	-0.8224	0.5680	0.814	1.0000	
SURVIVAL	-0.4653	0.7553	-0.7010	-0.723	-0.8356	1.0000

Hatchery Subyearling Chinook Survival vs WTT and Spill Proportion



Probability of being transported

Salmonid Group	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Chinook								0.52 (H)		0.52 (H)
Sub Yearlings	0.87	0.93	0.96	0.93	0.90	0.97	0.81	0.56(W)	0.42 (H)	0.43 (W)

Conclusions

- For actively migrating subyearling Chinook, increased spill and decreased water transit time (higher flows) appear to improve survival, while higher temperatures decrease survival
- Survivals were relatively high in 2008 because of high flows through June, spill and cool temperatures