

# Route-Specific Survival of Juvenile Salmonids at McNary Dam, 2012

James S. Hughes

Mark Weiland, Gene Ploskey, Christa Woodley, Scott Carpenter\*, Fenton Khan, Eric Fischer, Aaron Cushing\*, Tyler Mitchell\*, Darin Etherington\*, Matt Hennen\*, George Batten\*, Shon Zimmerman, Michael Greiner, Bishes Rayamajhi, Jina Kim, Tao Fu, Jayson Martinez, Yong Yuan, Marty Ingraham, Tylor Abel, Xinya Li, Daniel Deng, and Tom Carlson

**Pacific Northwest National Laboratory**

**\*Pacific States Marine Fisheries Commission**



# Goal

- ▶ Evaluate route-specific survival and associated passage metrics for juvenile steelhead and yearling and subyearling Chinook salmon at McNary Dam (MCN) in spring and summer 2012

# Objectives

- ▶ Study objectives included evaluating the following metrics:
  - Passage efficiencies
  - Survival by route
  - Passage distributions
  - Travel times
- ▶ Historical context - survival
  - Top-spill weirs (TSWs)
  - Juvenile Bypass System (JBS)

# Study Area



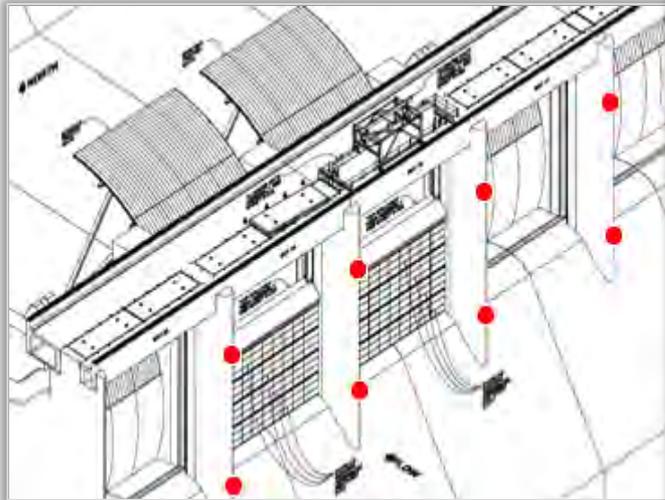
# Hydrophone Locations



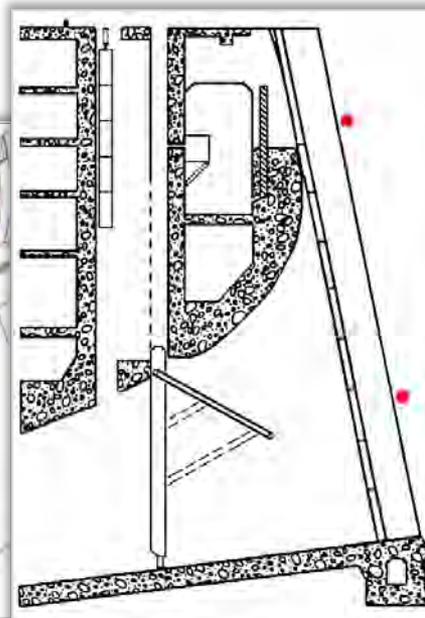
# Hydrophone Deployment



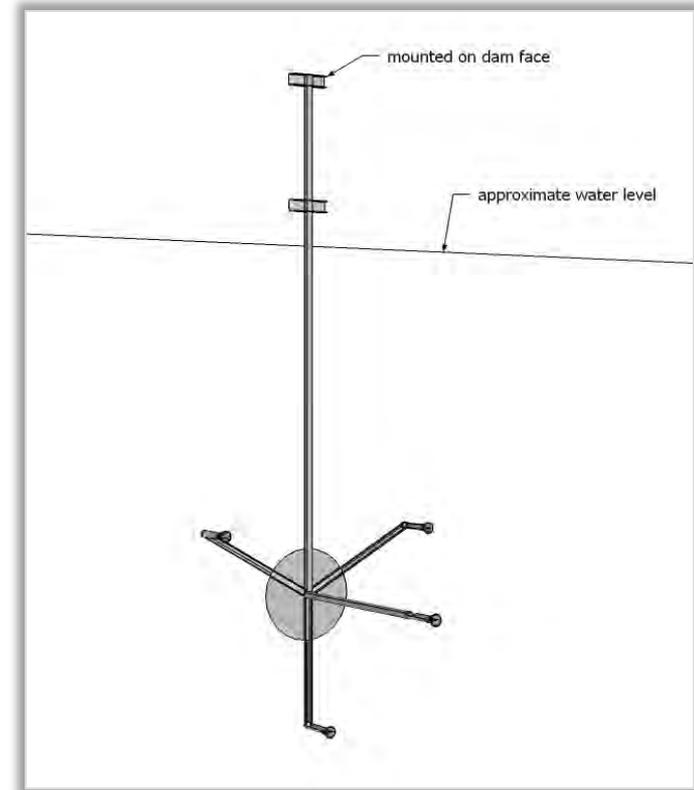
Spillway



Powerhouse



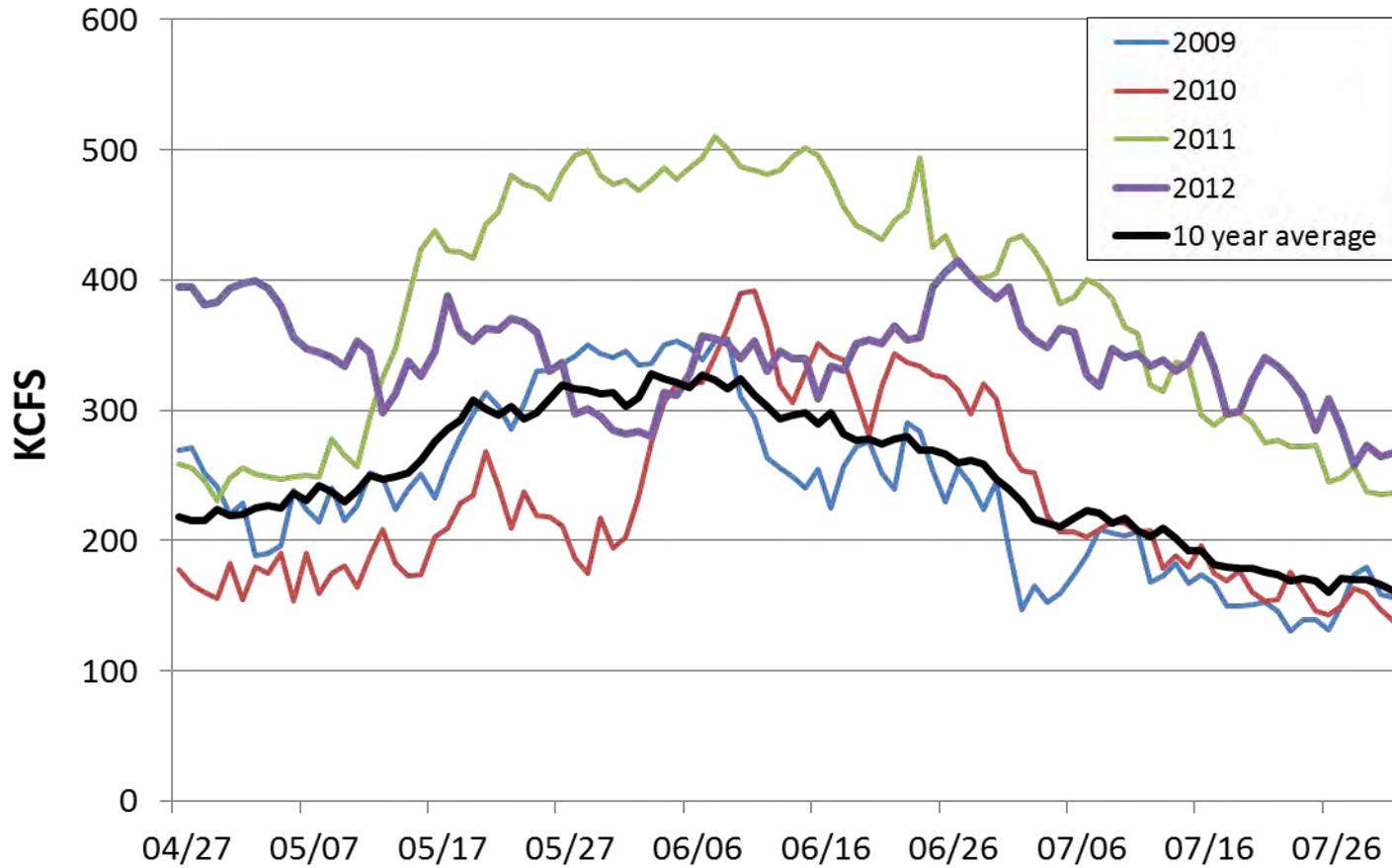
Star Array



# Fish Release

Release Location	Juvenile Steelhead	Yearling Chinook	Subyearling Chinook
$R_1$ Port Kelley, WA (rkm 503)	1,400	1,399	2,524
$R_2$ Umatilla, OR (rkm 468)	1,199	1,198	1,993
$R_3$ Crow Butte, WA (rkm 422)	1,198	1,200	1,984
	3,797	3,797	6,501

# Flow Conditions



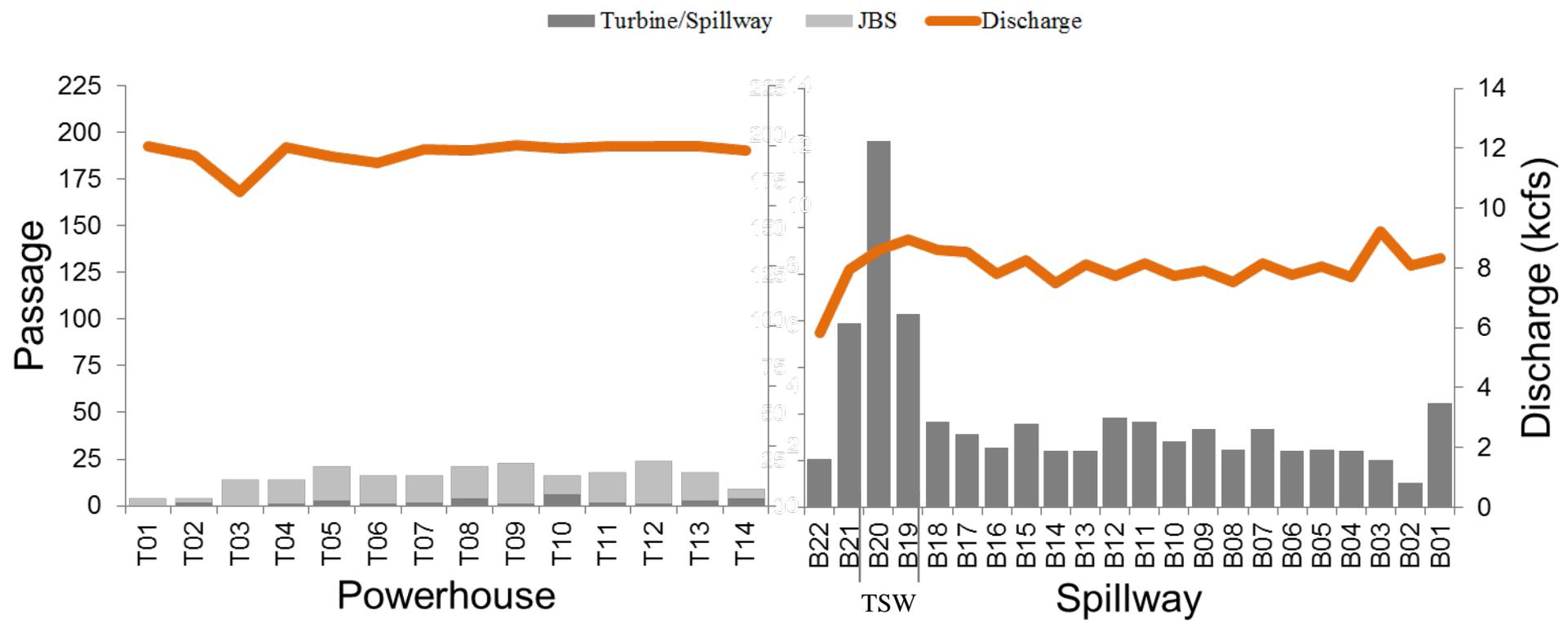
# Passage Efficiencies: Juvenile Steelhead

2012 Passage Metrics	
Spill Passage Efficiency (SPE)	0.832
Fish Passage Efficiency (FPE)	0.977
Fish Guidance Efficiency (FGE)	0.862
TSW Efficiency (TSWE)    Spillway	0.279
TSW Efficiency (TSWE)    Dam	0.233
Bypass Efficiency (BPE)	0.145

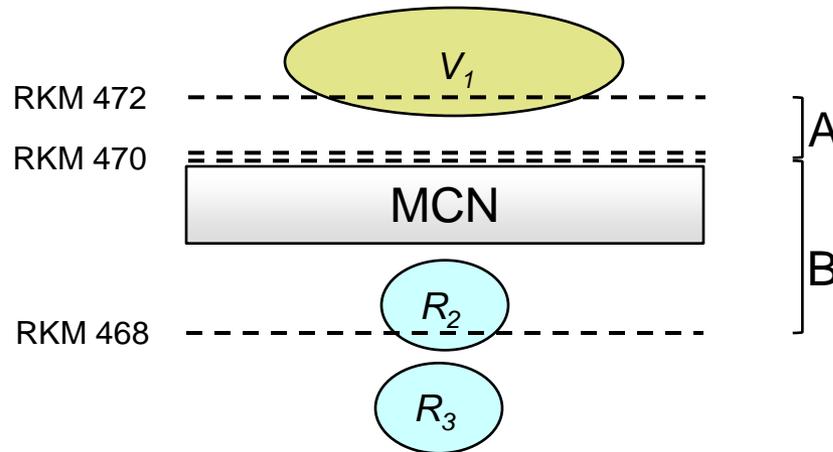
# Survival by Route: Juvenile Steelhead

Route	Survival				Passage Proportion
	Paired Release	$V_1$	$R_2$	$R_3$	
Dam Passage	0.991 (0.018)	0.914 (0.008)	0.828 (0.011)	0.898 (0.009)	
Forebay-to-Tailrace	0.988 (0.018)	0.911 (0.008)			
Turbine	0.831 (0.085)	0.767 (0.077)			0.021
TSW	0.976 (0.025)	0.900 (0.017)			0.215
Non-TSW	1.001 (0.019)	0.923 (0.010)			0.554
Spillway	0.994 (0.019)	0.916 (0.008)			0.769
JBS – rkm 309	1.015 (0.026)	0.936 (0.018)	↓	↓	
JBS – rkm 325	1.026 (0.024)	0.9358 (0.018)	0.854 (0.010)	0.937 (0.007)	0.134

# Passage Distributions: Juvenile Steelhead



# Travel Times: Juvenile Steelhead



	Median (h)
A - Forebay Residence	1.8
B - Tailrace Egress	0.3

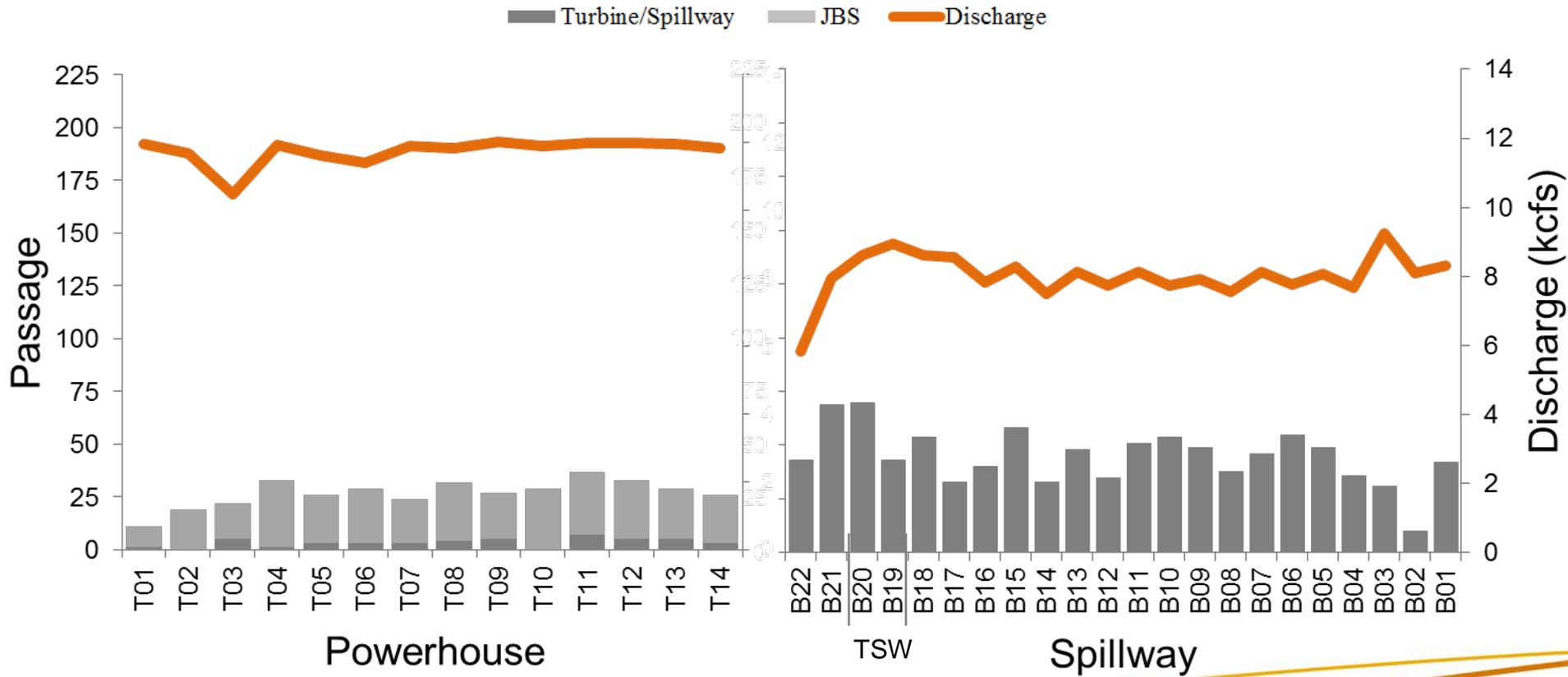
# Passage Efficiencies: Yearling Chinook

2012 Passage Metrics	
Spill Passage Efficiency (SPE)	0.725
Fish Passage Efficiency (FPE)	0.968
Fish Guidance Efficiency (FGE)	0.882
TSW Efficiency (TSWE)    Spillway	0.115
TSW Efficiency (TSWE)    Dam	0.083
Bypass Efficiency (BPE)	0.242

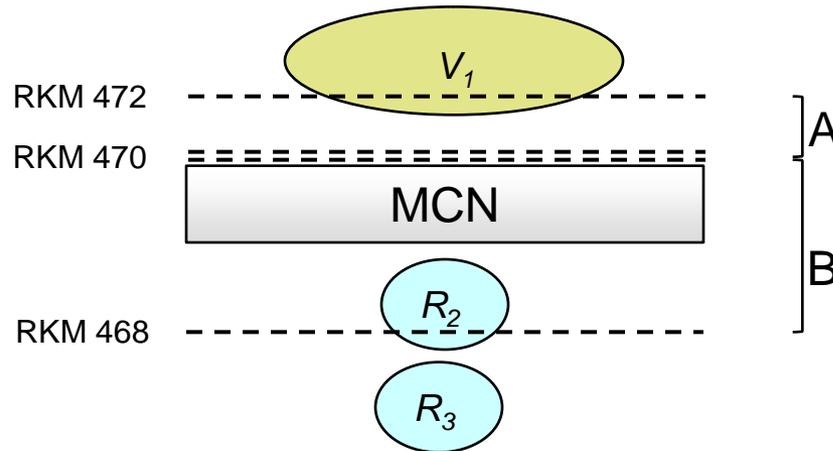
# Survival by Route: Yearling Chinook

Route	Survival				Passage Proportion
	Paired Release	$V_1$	$R_2$	$R_3$	
Dam Passage	0.962 (0.014)	0.917 (0.008)	0.905 (0.009)	0.949 (0.007)	
Forebay-to-Tailrace	0.960 (0.014)	0.915 (0.008)			
JBS	0.936 (0.021)	0.892 (0.017)			0.234
Turbine	0.955 (0.047)	0.911 (0.043)			0.031
TSW	0.976 (0.028)	0.931 (0.024)			0.081
Non-TSW	0.971 (0.015)	0.926 (0.009)			0.623
Spillway	0.971 (0.015)	0.926 (0.008)			0.703

# Passage Distributions: Yearling Chinook



# Travel Times: Yearling Chinook



	Median (h)
A - Forebay Residence	1.8
B - Tailrace Egress	0.4

# Passage Efficiencies by Route: Subyearling Chinook

## 2012 Passage Metrics

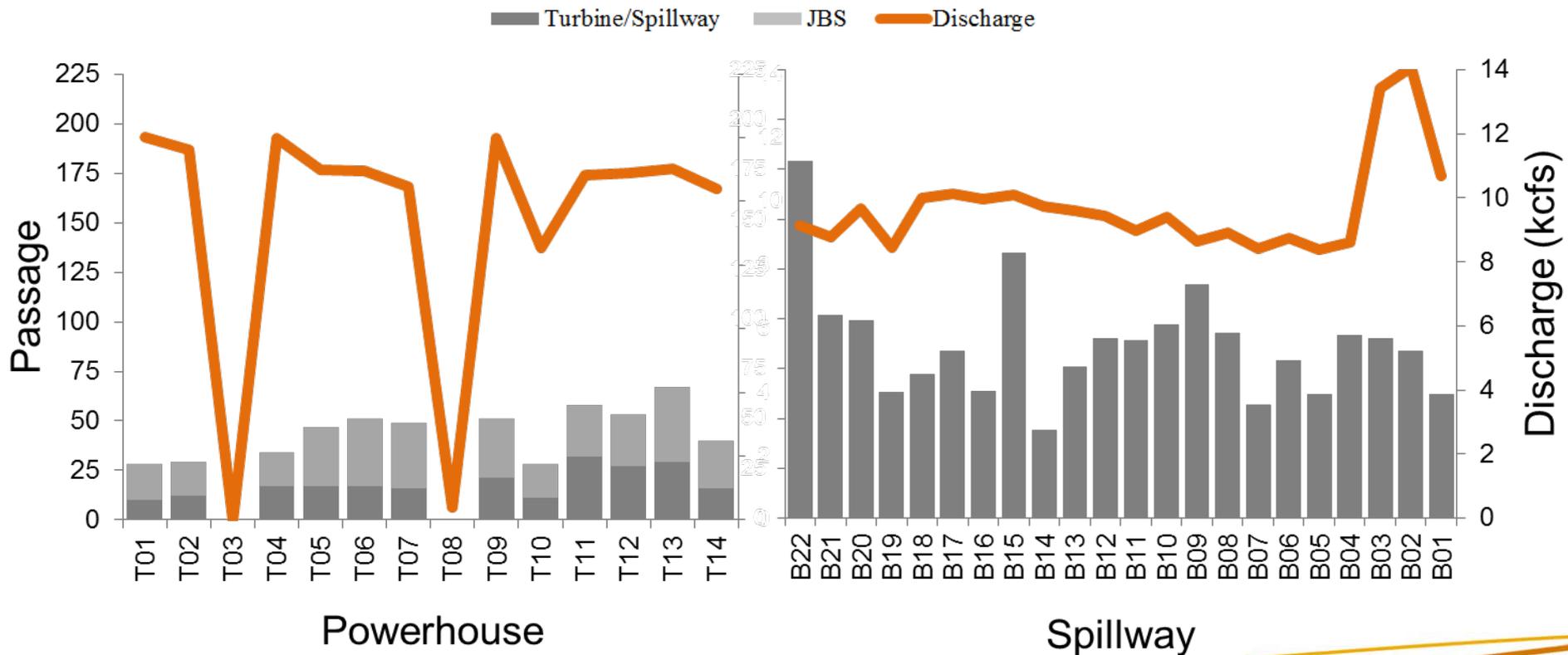
Spill Passage Efficiency (SPE)	0.783
Fish Passage Efficiency (FPE)	0.909
Fish Guidance Efficiency (FGE)	0.578
Bypass Efficiency (BPE)	0.125

# Survival by Route: Subyearling Chinook

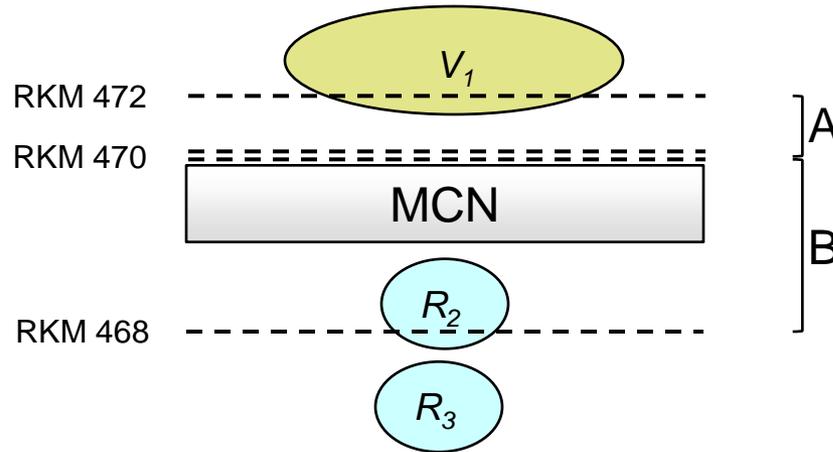
► TSWs were not installed during the summer season

Route	Survival				Passage Proportion
	Paired Release	$V_1$	$R_2$	$R_3$	
Dam Passage	0.975 (0.011)	0.915 (0.006)	0.886 (0.007)	0.944 (0.006)	
Forebay-to-Tailrace	0.973 (0.011)	0.913 (0.006)	0.886 (0.008)	0.944 (0.006)	
JBS	1.008 (0.017)	0.946 (0.013)	0.886 (0.008)	0.944 (0.006)	0.122
Turbine	0.881 (0.028)	0.827 (0.025)	0.886 (0.008)	0.944 (0.006)	0.089
Spillway	0.980 (0.012)	0.920 (0.006)	0.886 (0.007)	0.944 (0.006)	0.763

# Passage Distributions: Subyearling Chinook



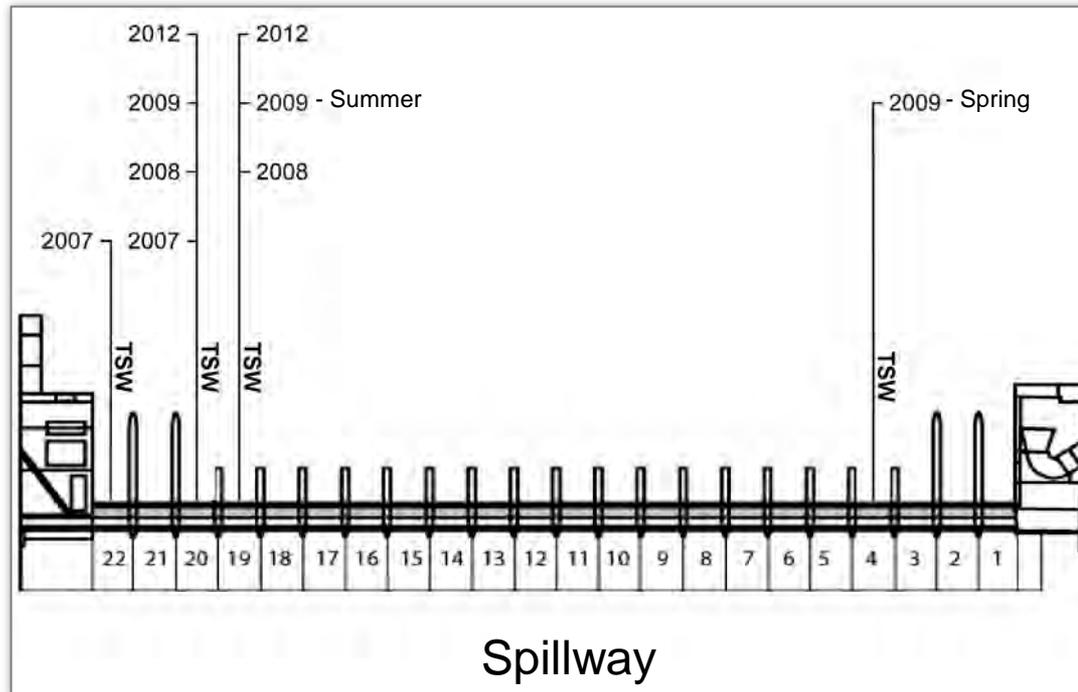
# Travel Times: Subyearling Chinook



	Median (h)
A - Forebay Residence	1.8
B - Tailrace Egress	0.4

# TSW Survival – Historical Context

- ▶ TSW survival estimates from 2007 - 2009 were single-release-recapture design
- ▶ Location of TSWs from 2007 - 2009 and 2012



# TSW Survival – Historical Context

TSW Survival	Single Release				Paired
	2007*	2008*	2009*	2012	2012
Steelhead	0.906 (22)	0.967 (20)	0.961 (20)	0.900	0.976
	0.967 (20)	0.972 (19)	0.967 (19)		
Yearling Chinook	0.922 (20)	0.906 (19)	0.961 (20)	0.931	0.976
	0.935 (22)	0.965 (20)	0.984 (4)		
Subyearling Chinook	0.828 (20)	0.889 (19)	0.822 (19)	N/A	N/A
	0.881 (22)	0.912 (20)	0.847 (20)		

\*Adams, N.S., and Evans, S.D., eds., 2011, Summary of juvenile salmonid passage and survival at McNary Dam - Acoustic survival studies, 2006–09: U.S. Geological Survey Open-File Report 2011-1179, 144 p.

# JBS Survival – Historical Context

- ▶ Juvenile bypass outfall extended to mid-channel in early 2012
- ▶ Survival estimates from 2006 – 2009 used single-release-recapture design

JBS Survival	Single Release					Paired
	2006*	2007*	2008*	2009*	2012	2012
Steelhead	0.976	0.859	0.992	0.957	0.936	1.015
Yearling Chinook	0.945	0.916	0.946	0.955	0.892	0.936
Subyearling Chinook	0.921	0.869	0.845	0.855	0.946	1.008

\*Adams, N.S., and Evans, S.D., eds., 2011, Summary of juvenile salmonid passage and survival at McNary Dam - Acoustic survival studies, 2006–09: U.S. Geological Survey Open-File Report 2011-1179, 144 p.

# Summary and Conclusions

- ▶ Discharge was notably higher than the ten-year average during the majority of the spring and summer season
- ▶ TSW
  - Single-release survival through the TSW in 2012 was near the lower end of the historical range (2007 – 2009) for juvenile steelhead with 90.0% survival and historically similar for yearling Chinook
- ▶ JBS
  - JBS single-release survival was higher in 2012 for subyearling Chinook (~3%-10%) than previous year's estimates (2006-2009), lower for yearling Chinook salmon and similar for juvenile steelhead

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