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Programmatic Synthesis and Evaluation: An Example from the Columbia Estuary Ecosystem Restoration Program

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Objectives

- Describe the basics of programmatic synthesis and evaluation (S&E).
- Provide an overview of a recent effort to synthesize and evaluate the Columbia Estuary Ecosystem Restoration Program.
- Stimulate subsequent discussions about S&E for the Willamette Basin RM&E Program.

Background

- What is Synthesis and Evaluation (S&E)
  - Synthesis is the compilation and summarization of data from multiple sources to discern patterns, commonalities, consistencies, and contradictions in the findings.
  - Evaluation is answering a question(s) about the performance or a hypothesis about the system.
  - Thus, synthesis and evaluation attempts to analyze data and integrate information from multiple studies to find common themes and patterns.
- Why is S&E important?
  - In any multi-year, multi-objective program, it is essential to “capture the learning” (Pat Poe, BPA, 1994).
  - Results from synthesis and evaluation are used to inform management decisions concerning program direction and priorities.

Adaptive Management of the Estuary Restoration Program

- The “Synthesis Memorandum” contains the results of S&E.

Process to Develop the CEERP S&E Report

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1) Identify key **management questions** to assure the effort meets programmatic needs
2) Develop S&E **objectives** to focus the work
3) Establish a **Steering Team** to oversee and guide the effort
4) Convene **sub-teams** to carry out specific work
5) Produce a progression of **draft reports**:
    a) 30% -- detailed outline with management questions and objectives
    b) 60% -- some draft chapters, plans for other chapters
    c) 90% -- complete draft
6) Institute a comprehensive **peer-review** for each draft report

CEERP Synthesis and Evaluation

Columbia Estuary Ecosystem Restoration Program

2018 SYNTHESIS MEMORANDUM

90% DRAFT

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U.S. DEPARTMENT OF COMMERCE

Example of Synthesis for the Estuary

- Qualitative meta-analysis of site-specific monitoring data.

Project	WSE	Water Temp	Sediment Accretion	Channel X-sec	Vege-tation	Macro-inverts	Fish Capture	Fish PIT
Batwater Station	A	C	B			X	B	
Colewort Slough	X	X	X			X		C[c]
Crims Island	A[a]	C[a]	B[a]	B[b]	B[a]	C[b]	B[a]	
Dibblee Point	A	D	X		X	X	B	
Elochoman Slough Thomas	C	C	B		X	X		
Fort Clatsop/South Slough	A[a]	B[a]		X	X		C[a]	
Fort Columbia		X		X			B[3]	C[c]
Horsetail Creek	X	X	X	X				D
JBH Mainland	C[a]	C[a]					B[a]	
Kandoll Farm #2	X	X	D	B	X	X		
Karlson Island	A	B	D				B	
LA (Louisiana) Swamp	B	C	B	X	X			
La Center Wetlands	A	C	C		X	X		
Mill Road	X		X	B	X			
Mirror Lake		X		X		X	B	
Multnomah Ch Metro	X	X					B	C
North Unit Ruby	A	C	B		X	X		
North Unit Widgeon	B	C	B		X	X		
North Unit Three Fingered	A	B	X					
Sandy River Dam	C[d]	C[d]		A[d]	X	X	B	
Steamboat Slough	X	X	X	X	X	X	B	B
Vera Slough	D[a]	D[a]	B[a]	C[e]	D[a]		C[a]	
Wallacut	X	X	C	C	X			

S&E Example -- Surface Flow Outlet Compendium

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ENSR | AECOM

Prepared for:
U.S. Army Corps of Engineers
Portland District

Surface Bypass Program
Comprehensive Review Report

Contract No. W9127N-06-D-0004, T.O. 01

ENSR Corporation
December 31, 2007
Document No.: 09000-399-0409

Synthesized data on surface flow outlet performance

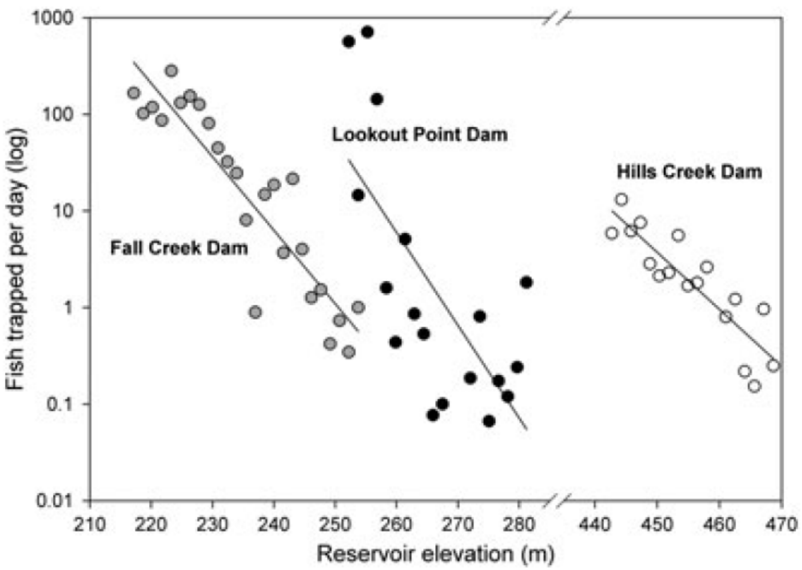
(From Table 4-3. Bio-index data for each species averaged across SFO type.

SFO Type	Yearling Chinook	Steelhead	Coho	Sockeye	Run-at-Large Spring	Bio-Index Spring	Subyearling Chinook	Run-at-Large Summer	Bio-Index Summer
Forebay Collector	0.30	0.67	---	0.37	---	0.45	0.25	---	0.25
Retrofit	0.31	0.38	0.30	---	0.44	0.40	---	0.45	0.45
Sluiceway	0.19	0.45	---	---	0.20	0.24	0.34	0.21	0.22
Surface Spill	0.34	0.48	---	---	0.38	0.34	0.64	0.32	0.41
Overall Mean	0.27	0.46	0.30	0.37	0.30	0.33	0.38	0.29	0.32

S&E Example from the Willamette – Keefer et al. (2013)

Synthesized data on passage at three dams in Willamette R basin.

(From Figure 4.)



HIGH-HEAD DAMS AFFECT DOWNSTREAM FISH PASSAGE TIMING AND SURVIVAL IN THE MIDDLE FORK WILLAMETTE RIVER

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ABSTRACT

Many high-head dams in Oregon's Willamette River basin were constructed without fish passage facilities for downstream migrants. Instead, fish pass dams via hydroelectric turbines, surface spillways or deep-water regulating outlets. The availability of these routes varies seasonally with dam operations and reservoir depth, which can fluctuate by tens of meters.

To assess how dam and reservoir operations affect fish movement timing and survival, we used rotary screw traps below three Willamette basin dams and at two riverine sites above reservoirs. Traps were operated 2950 days over 8 years, and >195 000 fish were collected. Samples above reservoirs were primarily native salmonids (*Oncorhynchus* spp.), daces (*Rhinichthys* spp.) and sculpins (*Cottus* spp.), while those below dams were often dominated by non-native Centrarchidae. Capture rates at riverine sites were highest from late winter to early summer, coincident with juvenile Chinook salmon emigration. Conversely, collection below dams was largely restricted to late fall and winter when reservoirs were drawn down to annual lows and discharge was high. We hypothesize that winter operations facilitated fish access to dam turbines and regulating outlets, whereas spring–summer operations entrapped fish in reservoirs and restricted volitional downstream passage.

Total fish mortality was ≤2% at riverine sites and was 36–69% below dams. Estimates were highest for non-native species and juvenile Chinook salmon. Fatal injuries were consistent with traumas related to pressure, shear and contact and there were size-related and morphology-related risk differences. Mitigation opportunities include fish bypass system development, retrofits for existing routes and seasonally appropriate reservoir draw down to allow fish passage.

KEY WORDS: entrainment; high-head dam; reservoir entrapment; turbine mortality; Willamette River

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INTRODUCTION

High-head, flood-control dams in Oregon's Willamette River basin present a variety of fish passage challenges. Most of the dams are located in major tributaries and were constructed without fish facilities for either upstream or downstream passage (Myers *et al.*, 2006; NMFS, 2008). Consequently, native fish movements associated with seasonal habitat use or life history requirements can be severely restricted. Anadromous species, including ESA-listed spring Chinook salmon (*Oncorhynchus tshawytscha*) and winter steelhead (*Oncorhynchus mykiss*) are among the most impacted species because dams block adult access to historic spawning areas (Myers *et al.*, 2006; Sheer and Steel, 2006) and restrict emigration of juveniles outplanted from hatcheries or produced by adults released above dams (NMFS, 2008; Keefer *et al.*, 2010). The dams also affect the abundance, movement and distribution of non-native species by restricting some upstream range expansion and potentially also exporting exotics to downstream reaches and to habitats above reservoirs.

In this study, we used rotary screw traps to monitor downstream fish passage timing and survival in the Middle Fork Willamette River (hereafter, 'Middle Fork'). Fish were collected above reservoirs in lotic habitats where native fish assemblages are relatively intact and below three high-head dams whose reservoirs support a mix of native and non-native species. Dam passage routes were via hydroelectric turbines, low-elevation regulating outlets and (rarely) surface spillways. Turbine-related fish mortality and injury risks have been well documented at dams worldwide and stem from shear stress, blade strikes, cavitation, collisions and rapid pressure changes (Navarro *et al.*, 1996; Coutant and Whitney, 2000; Mathur *et al.*, 2000; Čada 2001; Čada *et al.*, 2006; Ferguson *et al.*, 2008). Surface spillway passage is generally more benign than turbine passage, although spillway height, plunge pool configuration and other features can cause mortality and a variety of injuries (Muir *et al.*, 2001; Schilt, 2007; Williams, 2008). There have been few studies of fish passage through the high-pressure, high-velocity regulating outlets that are typical at Willamette basin

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Willamette Fisheries Science Reviews

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Research Topic	2013	2014	2015	2016	2017	2018	Total
Juvenile passage, reservoir behavior, etc.	12	7	10	6	8	2	**45**
Adult passage, pre-spawn mortality, etc.	9	5	6	3	8	3	**34**
Fall Creek	2	5	6	1	2	5	**21**
Genetics, life histories	4	2	5	3	1	1	**16**
Water quality (temp, turbidity, TDG, etc.)	3	2	1	3	4	2	**15**
Population status, modelling, VSP	2	2	2	5	0	3	**14**
Restoration, geomorph, instream flows	1	0	1	2	5	2	**11**
High-head bypass tests	0	0	0	2	3	5	**10**
Wild fish surrogates	1	1	1	1	1	1	**6**
Hatchery M&E	5	1	0	0	0	0	**6**
Other (bull trout, lamprey, predation, etc.)	5	8	4	3	2	10	**32**
Total	**44**	**33**	**36**	**29**	**34**	**34**	**210**

General Thoughts on S&E for the Willamette RME Program

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- Recap the goals for the Willamette fisheries program and its RME program – why are we here?
- Revisit and update the key management questions – what are the programmatic needs?
- Develop S&E objectives – what is S&E going to do?
- Establish a process to accomplish S&E -- how is S&E going to get done?

Workers pondering how to get S&E done

I sure hope some day I get to work for the Corps...

circa, 2004

Go Beav's!   Thank you