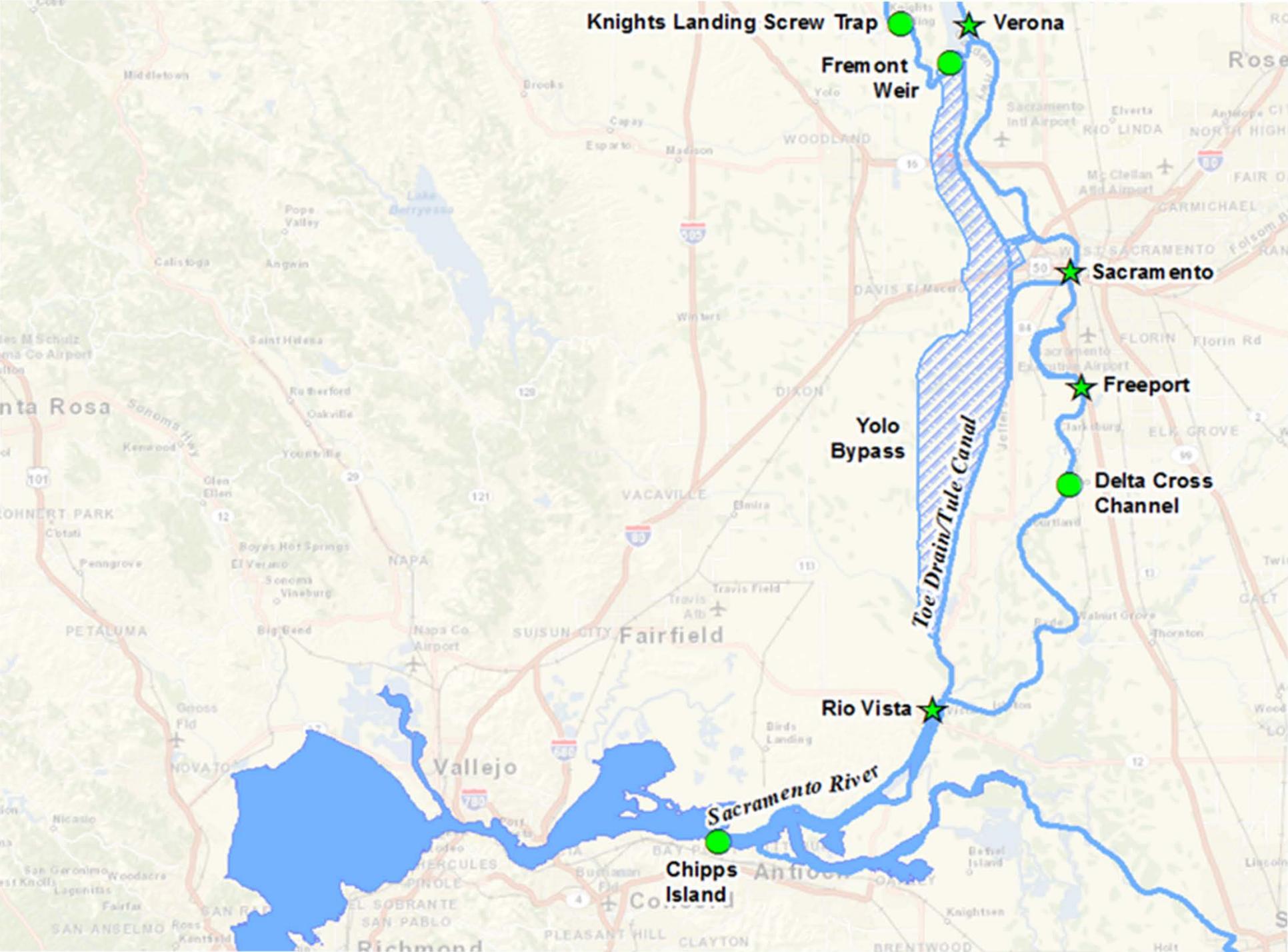


MODELING THE BENEFITS OF YOLO BYPASS RESTORATION ACTIONS ON CHINOOK SALMON



Paul Bergman, Travis Hinkelman, Joe Merz
Cramer Fish Sciences



Knights Landing Screw Trap

Verona

Fremont Weir

Sacramento

Freeport

Delta Cross Channel

Rio Vista

Chipps Island

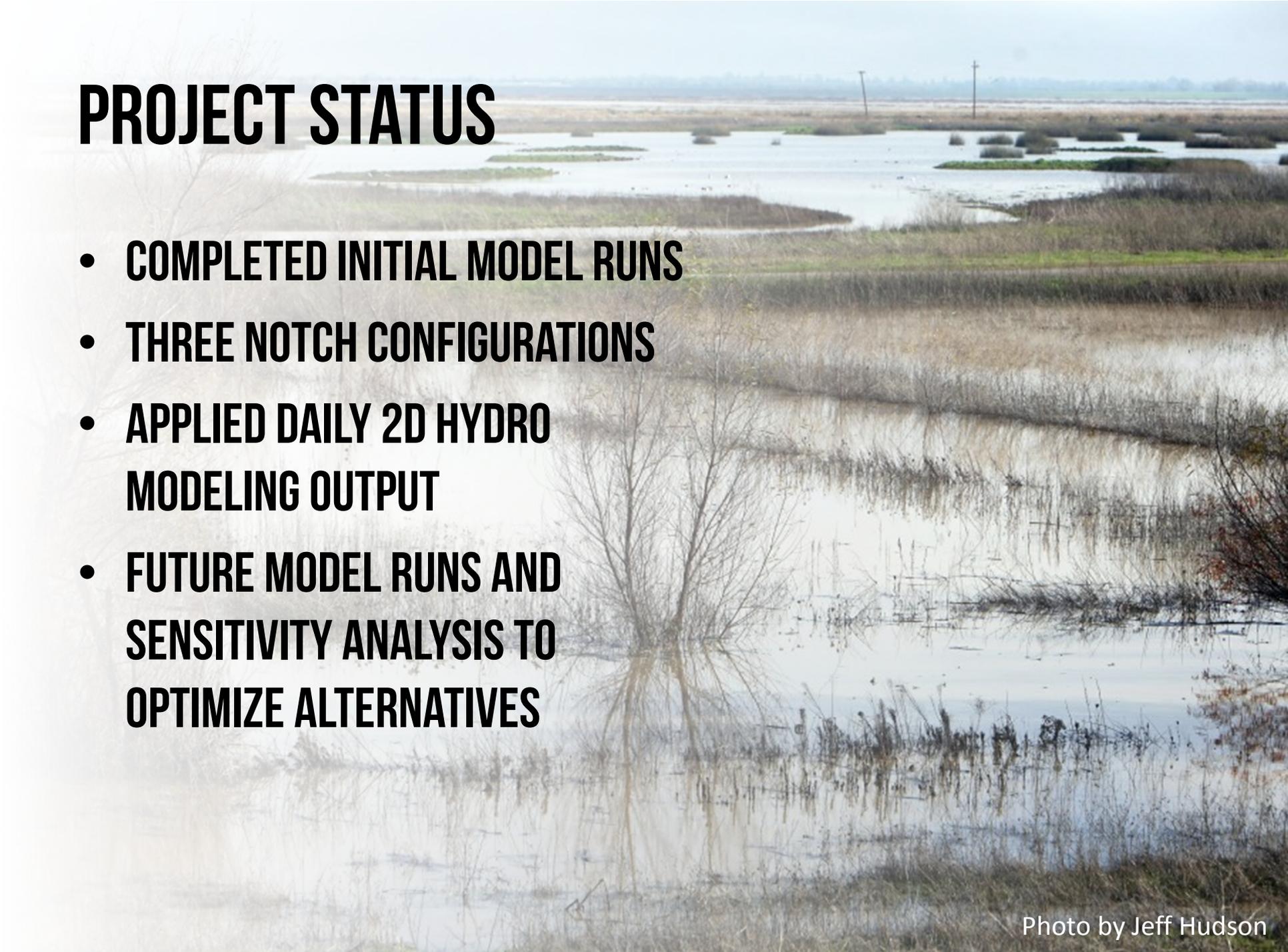
Yolo Bypass

Toe Drain/Tule Canal

Sacramento River

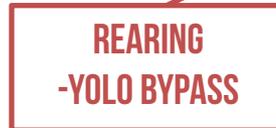
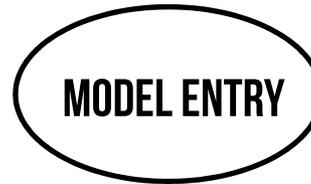
- 
- A wide, shallow river flows through a marshy landscape. The water is calm, reflecting the sky. The banks are covered in tall, golden-brown grasses. In the distance, a flat horizon line separates the land from a vast, blue sky filled with large, white, billowing clouds. The overall scene is serene and natural.
- **QUANTITATIVE ASSESSMENT OF BENEFITS TO FOUR SALMON RUNS**
 - **CREATE SIMULATION MODEL**
 - **TRACKS GROWTH, MOVEMENT, AND SURVIVAL OF SALMON**
 - **PROVIDES RELATIVE COMPARISON BETWEEN MANAGEMENT ALTERNATIVES**

PROJECT STATUS



- **COMPLETED INITIAL MODEL RUNS**
- **THREE NOTCH CONFIGURATIONS**
- **APPLIED DAILY 2D HYDRO MODELING OUTPUT**
- **FUTURE MODEL RUNS AND SENSITIVITY ANALYSIS TO OPTIMIZE ALTERNATIVES**

COMPONENTS

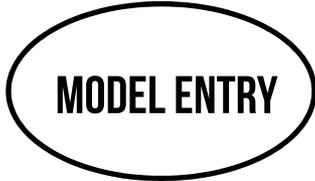


PLAN EFFECTS

DEMOGRAPHICS

COMPONENTS

EMIGRATION TIMING
FISH SIZE
INITIAL ABUNDANCE



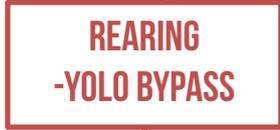
SEASONAL
INUNDATION
ACTIONS

% ENTRAINMENT



SEASONAL
INUNDATION
ACTIONS

SURVIVAL
MIGRATION RATE
GROWTH
CAPACITY



SURVIVAL



SURVIVAL



% SUCCESSFUL
PASSAGE



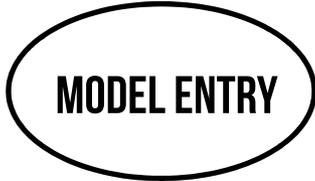
PLAN EFFECTS

DEMOGRAPHICS

COMPONENTS

RESULT METRICS

EMIGRATION TIMING
FISH SIZE
INITIAL ABUNDANCE



SEASONAL
INUNDATION
ACTIONS

% ENTRAINMENT



ENTRAINMENT

SEASONAL
INUNDATION
ACTIONS

SURVIVAL
MIGRATION RATE
GROWTH
CAPACITY



REARING SURVIVAL

SURVIVAL



SURVIVAL TO CHIPPS ISLAND
JUVENILE PRODUCTION

SURVIVAL



OCEAN SURVIVAL

% SUCCESSFUL
PASSAGE



ESCAPEMENT
JUVENILE-ADULT SURVIVAL

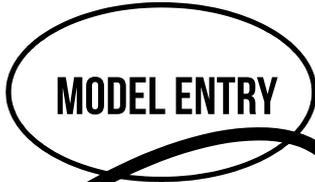
PLAN EFFECTS

DEMOGRAPHICS

COMPONENTS

RESULT METRICS

EMIGRATION TIMING
FISH SIZE
INITIAL ABUNDANCE



SEASONAL
INUNDATION
ACTIONS

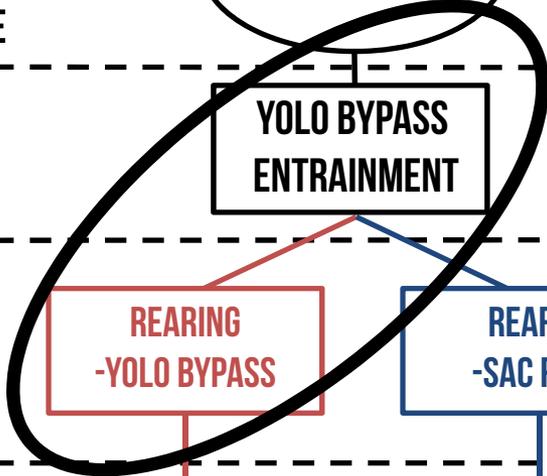
% ENTRAINMENT



ENTRAINMENT

SEASONAL
INUNDATION
ACTIONS

SURVIVAL
MIGRATION RATE
GROWTH
CAPACITY



REARING SURVIVAL

SURVIVAL



SURVIVAL TO CHIPPS ISLAND
JUVENILE PRODUCTION

SURVIVAL



OCEAN SURVIVAL

% SUCCESSFUL
PASSAGE

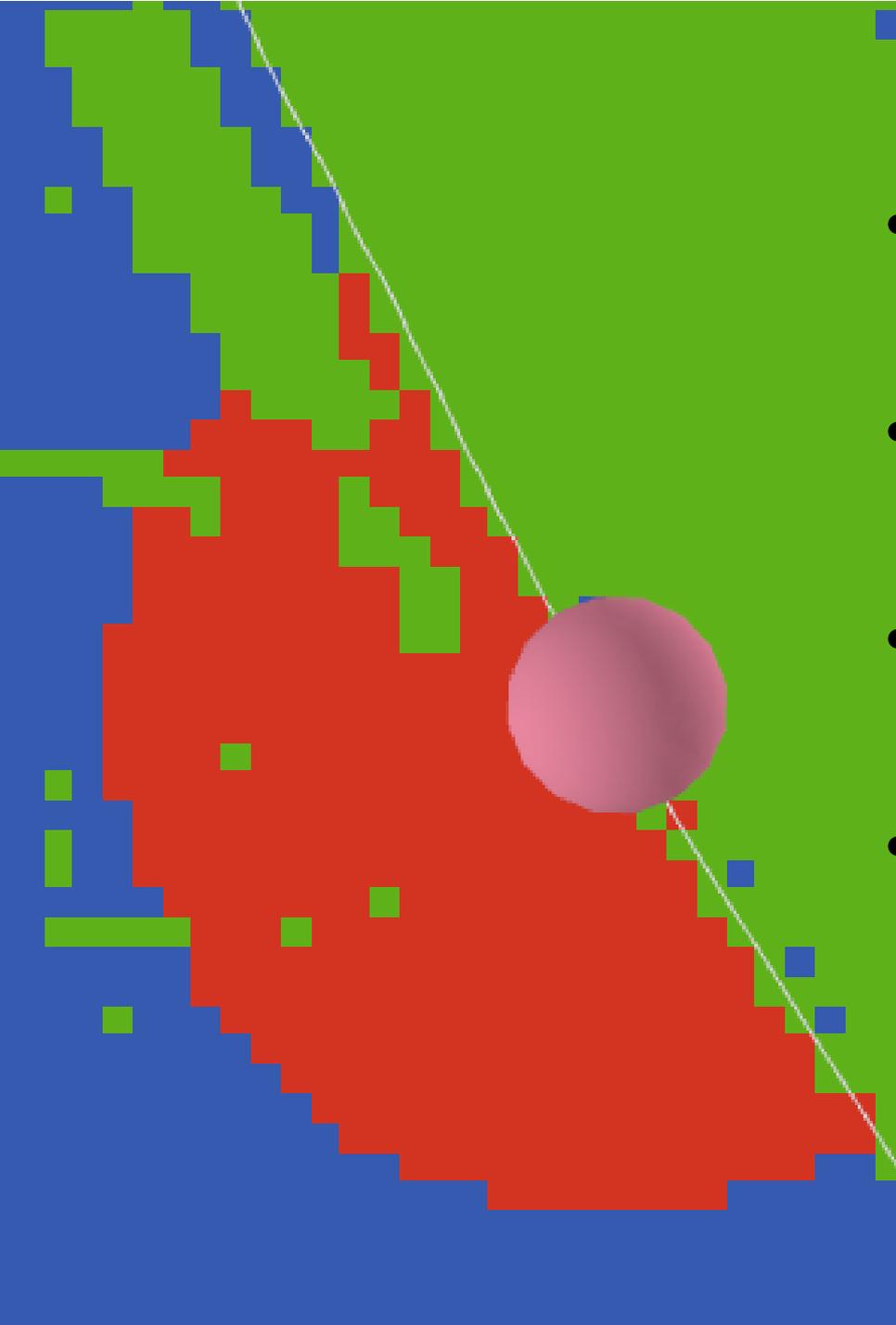


ESCAPEMENT
JUVENILE-ADULT SURVIVAL

BYPASS ENTRAINMENT

- **FISH ENTRAINMENT PROPORTIONAL TO FLOW**
 - **OVERTOPPING FREMONT WEIR**
 - **ALTERNATIVE CHANNEL**
- **ASSUME FISH ARE EQUALLY DISTRIBUTED**
- **ALTERNATIVE ENTRAINMENT FUNCTIONALITY WILL BE EVALUATED**





- **FISH REAR ON FLOODPLAIN WHEN SUITABLE HABITAT IS AVAILABLE**
- **FISH SEARCH RADIUS DEFINES AVAILABILITY**
- **FISH WILL OCCUPY AVAILABLE PATCHES**
- **STOP MOVING AND GROW AT A FASTER RATE**

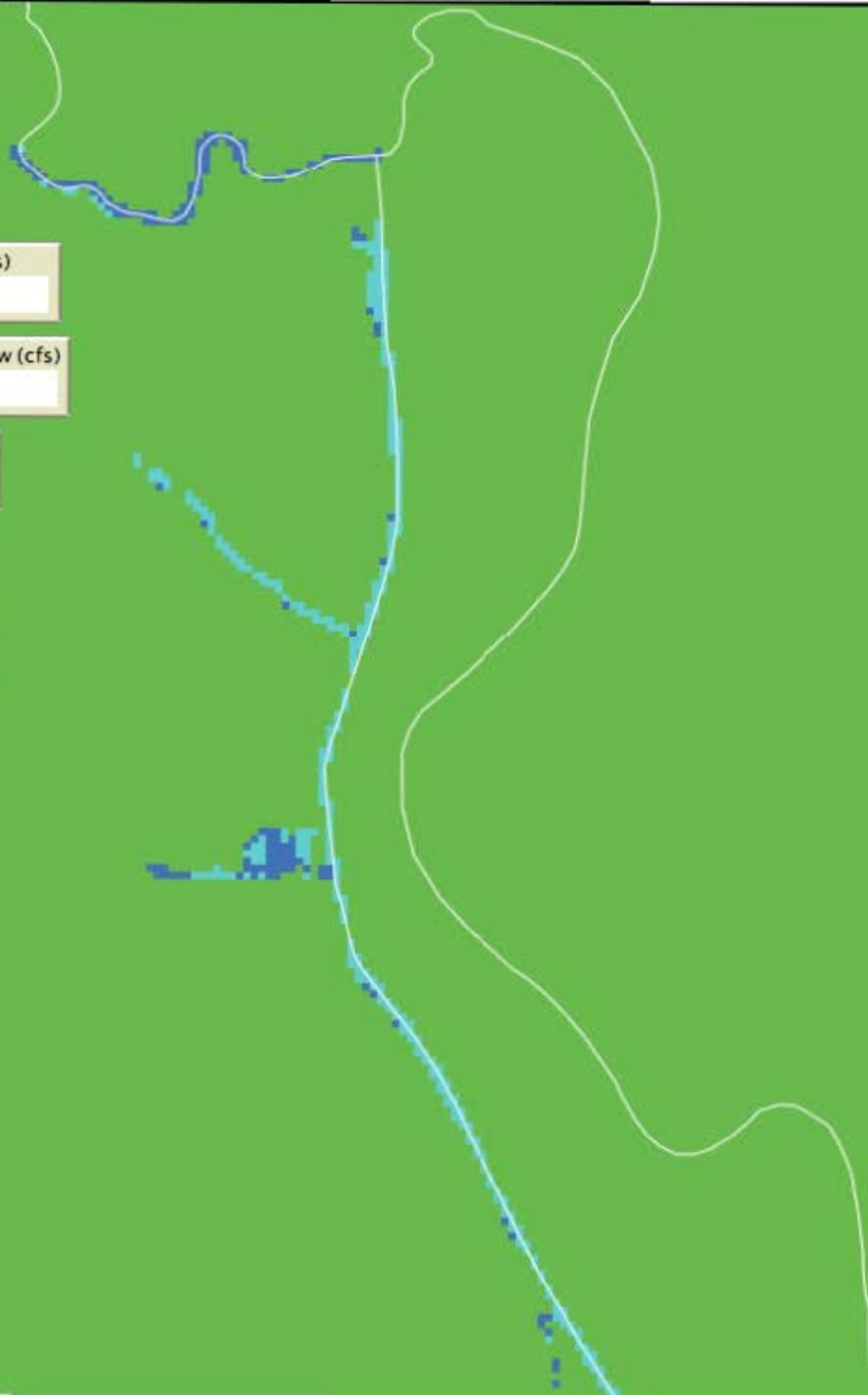
- 
- An underwater photograph of a stream. Several juvenile chinook salmon are swimming in the water. The water is clear and greenish. There are rocks and some aquatic plants visible. The fish are small and have a silvery color with dark spots. The text is overlaid on the right side of the image.
- **CAPACITY OF HABITAT DEFINED BY TERRITORY SIZES**
 - **REARING FISH ARE LIKELY SCHOOLING**
 - **NEUSWANGER ET AL. (2014)**
 - **3D VIDEO OF JUVENILE CHINOOK**
 - **FEEDING TERRITORIES (EXCLUSIVE SPACE) MAINTAINED IN SCHOOLS**

Fremont weir flow (cfs)
0

Alternative channel flow (cfs)
254

Flow proportion
0.03

Date
1998-11-15



PRELIMINARY RESULTS

A photograph of a concrete drainage ditch in a rural field. The ditch runs from the foreground into the distance, flanked by dry grass and trees. The sky is clear and blue.

- **4 SCENARIOS: SMALL, MEDIUM, AND LARGE NOTCHES AND EXISTING CONDITIONS**
- **15 WATER YEARS, 1997-2011**
- **HISTORICAL STARTING ABUNDANCES**
- **KNIGHTS LANDING SCREW TRAP FOR TIMING AND SIZE AT ENTRY**
- **ENTRAINMENT, JUVENILE PRODUCTION, AND OVERALL SURVIVAL**

ENTRAINMENT RESULTS

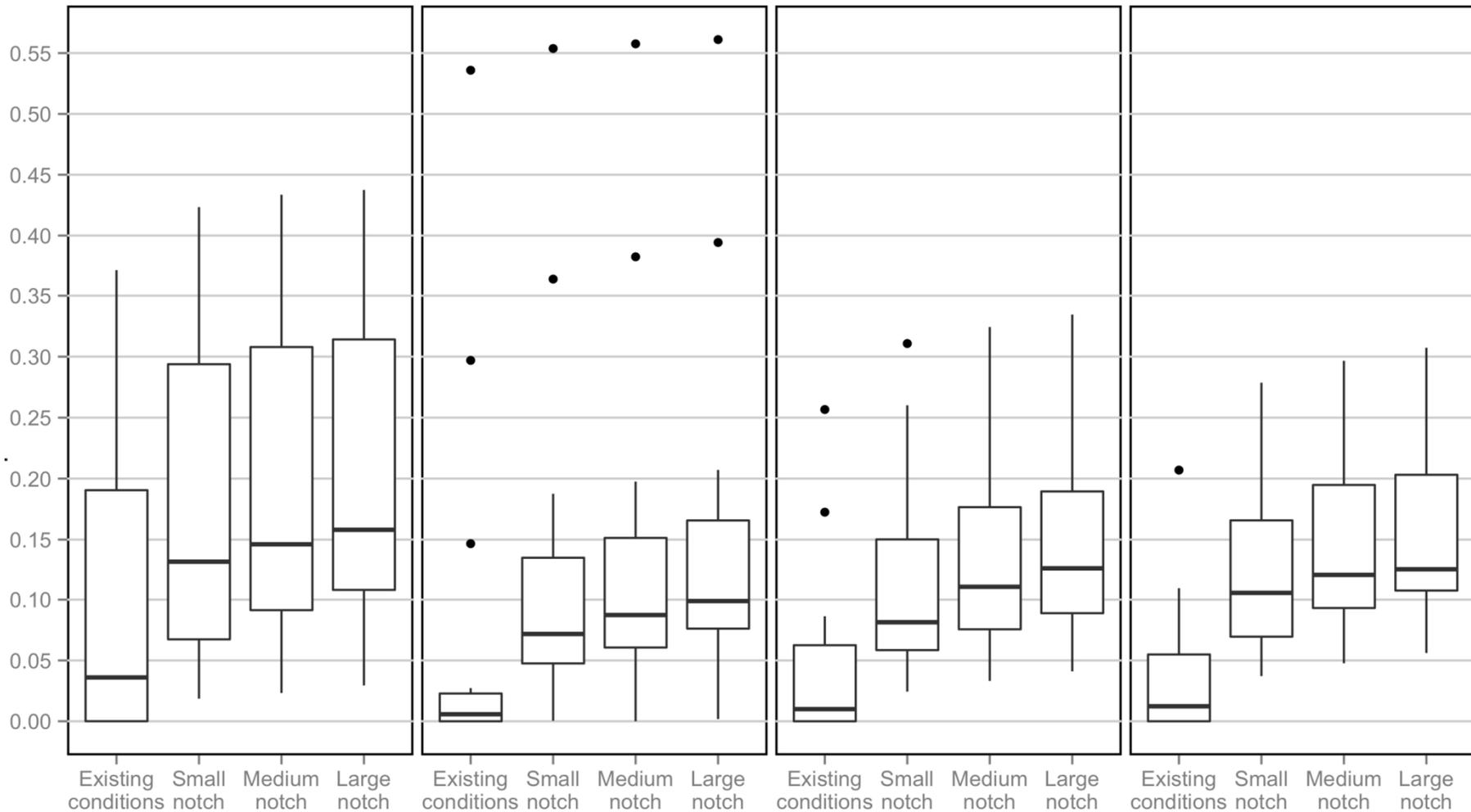
FALL

LATE-FALL

SPRING

WINTER

PROPORTION ENTRAINED



JUVENILE PRODUCTION RESULTS

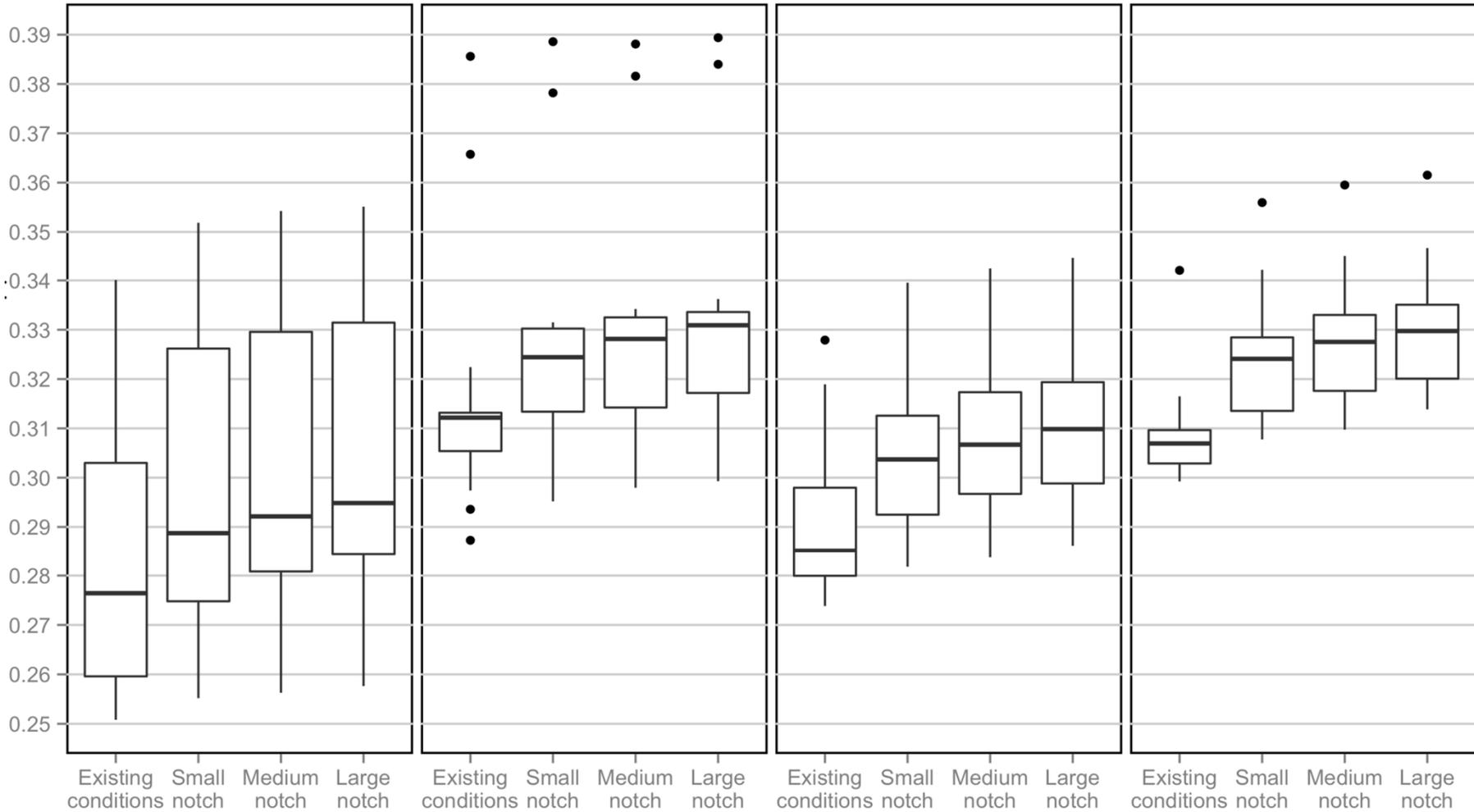
FALL

LATE-FALL

SPRING

WINTER

JUVENILE SURVIVAL TO CHIPPS ISLAND



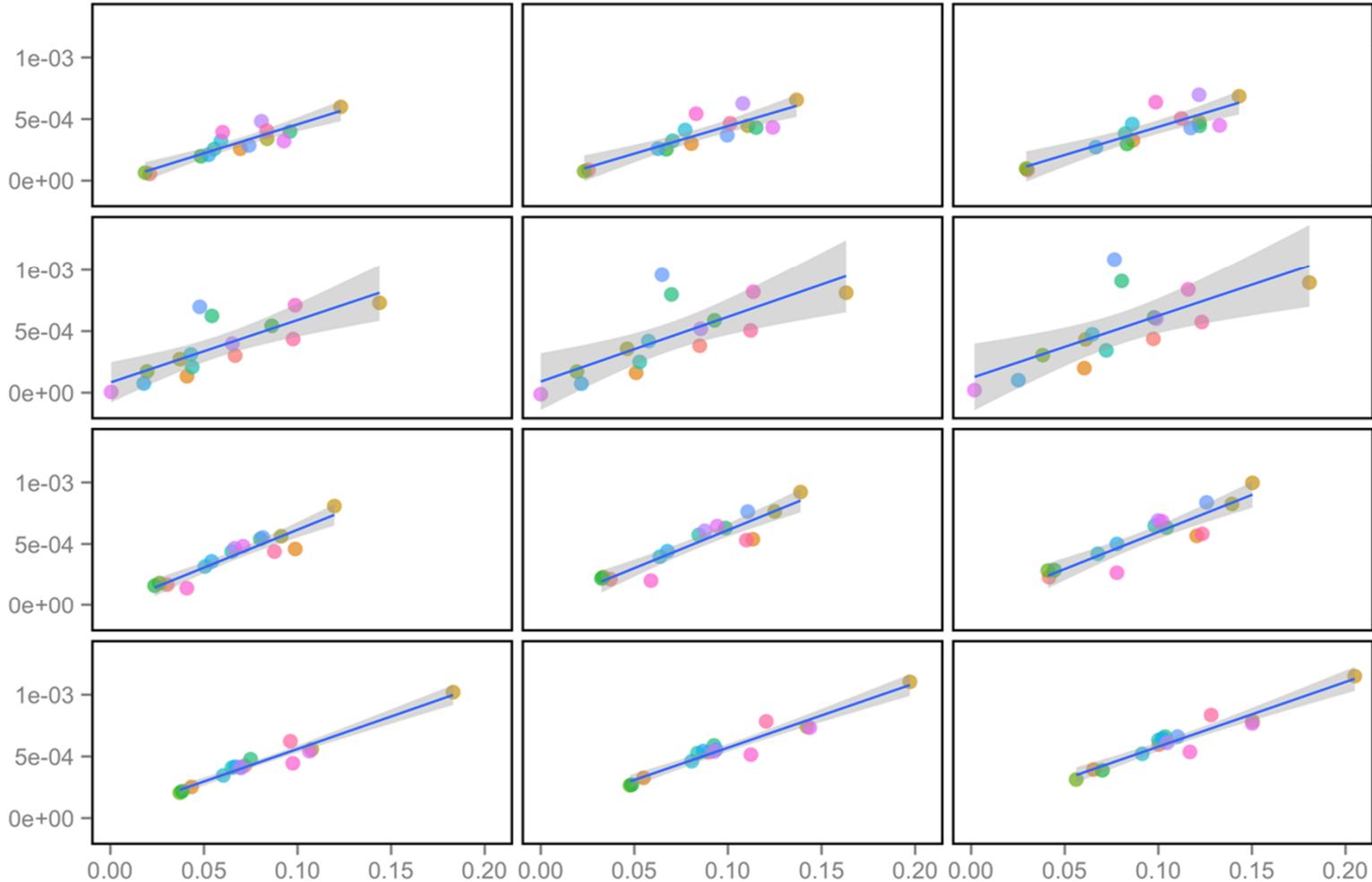
OVERALL SURVIVAL RESULTS

SMALL NOTCH

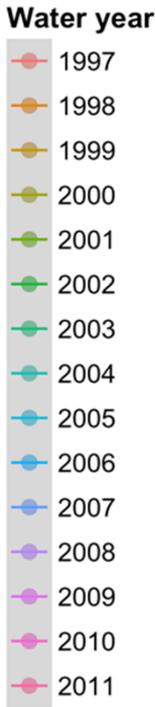
MEDIUM NOTCH

LARGE NOTCH

RELATIVE JUVENILE-TO-ADULT SURVIVAL



FALL
LATE-FALL
SPRING
WINTER



RELATIVE PROPORTION ENTRAINED

NEXT STEPS

- **MODEL ADDITIONAL ALTERNATIVES.**
- **DIFFERENT INUNDATION AREAS OR CHANGES TO CANAL COMPLEX DRAINAGE.**
- **OPTIMIZE OPERATIONS BY PERFORMING SENSITIVITY ANALYSES.**
- **ALTERNATIVE ENTRAINMENT HYPOTHESES.**

FREMONT WEIR TELEMETRY STUDY

- TRACK MOVEMENT OF WINTER-RUN CHINOOK JUVENILES ALONG FREMONT WEIR
- DESCRIBE CROSS-CHANNEL DISTRIBUTION
- INCORPORATE DATA INTO BEHAVIORAL MODEL
- OPTIMIZE NOTCH CONFIGURATION



ACKNOWLEDGEMENTS



**CDM
Smith**



**HAPPY
HALLOWEEN**