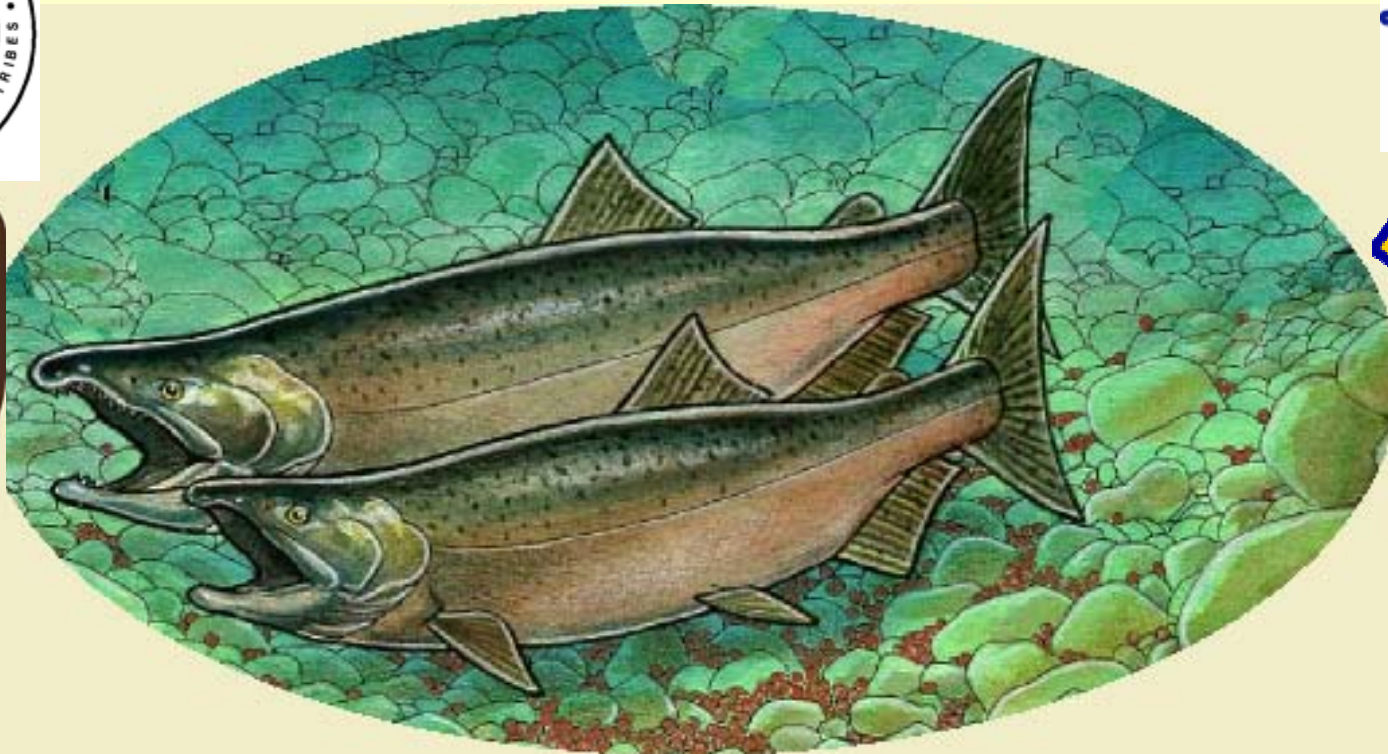# COMPARATIVE SURVIVAL STUDY (CSS) of PIT-tagged Spring/Summer Chinook and PIT-tagged Summer Steelhead 199602000

CBFWA Implementation Review

Mainstem/Systemwide Province

March 28, 2006
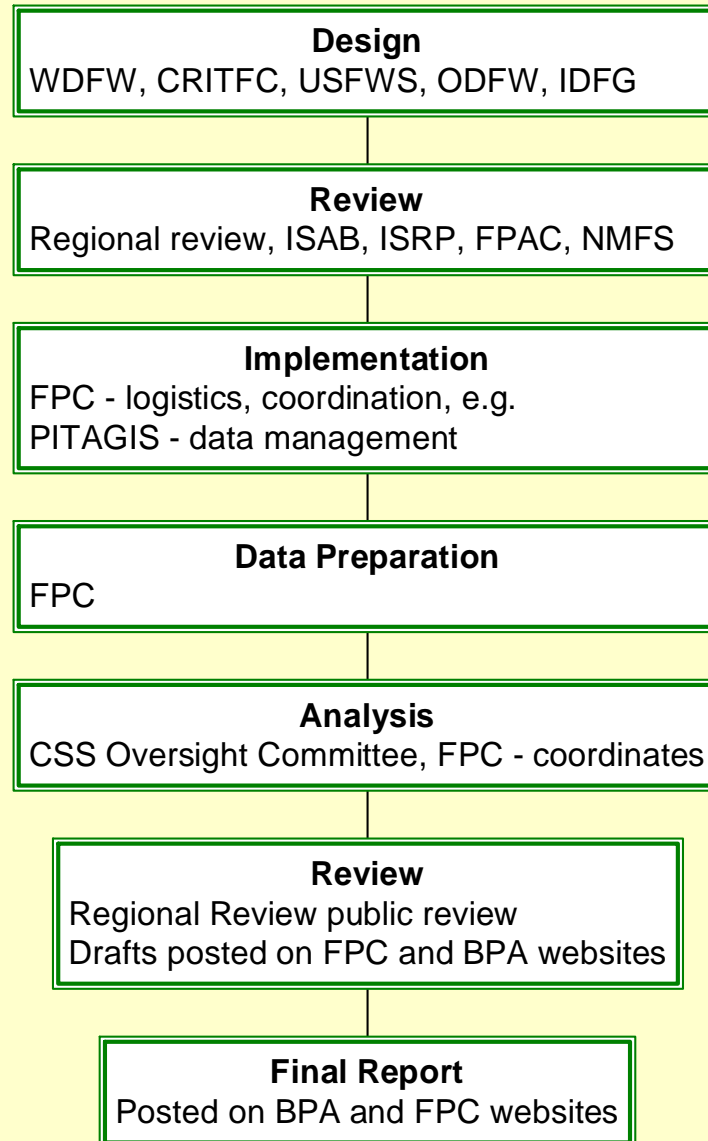
Fish Passage Center

Background

- **Study initiated in 1996 by states, tribes & FWS to estimate survival rates at various life stages**

- **Response to initial analysis by IDFG suggesting lower SARs for multiple bypass yearling chinook**

- **Develop a more representative control for transport evaluations**

- **Compare survival rates for chinook from 3 regions**

- **CSS information derived from PIT tags**

- **Collaborative scientific process was implemented to design studies and perform analyses**

- **CSS project independently reviewed and modified a number of times, primarily focusing on CIs about parameter estimates (ISAB, ISRP, etc.)**

The CSS is a joint project of the

state, tribal fishery managers and the US Fish and Wildlife Service

Design
WDFW, CRITFC, USFWS, ODFW, IDFG

Review
Regional review, ISAB, ISRP, FPAC, NMFS

Implementation
FPC - logistics, coordination, e.g.
PITAGIS - data management

Data Preparation
FPC

Analysis
CSS Oversight Committee, FPC - coordinates

Review
Regional Review public review
Drafts posted on FPC and BPA websites

Final Report
Posted on BPA and FPC websites

History of ISAB/ISRP Reviews of CSS

- **ISAB – Jan. 14, 1997 review of CSS followed by face-to-face meeting in Spokane Mar. 10, 1997**

- **ISAB – Jan. 6, 1998 review of CSS:**
  - *add steelhead; nonparametric bootstrap approach*

- **ISRP – July 16, 2002 and Sept. 24 2002**
  - *add chapter comparing bootstrap technique with likelihood-based CI*
  - *Began programming Monte Carlo simulation to evaluate bootstrap CI coverage*

- **ISAB – Jan. 27, 2006 review meeting**
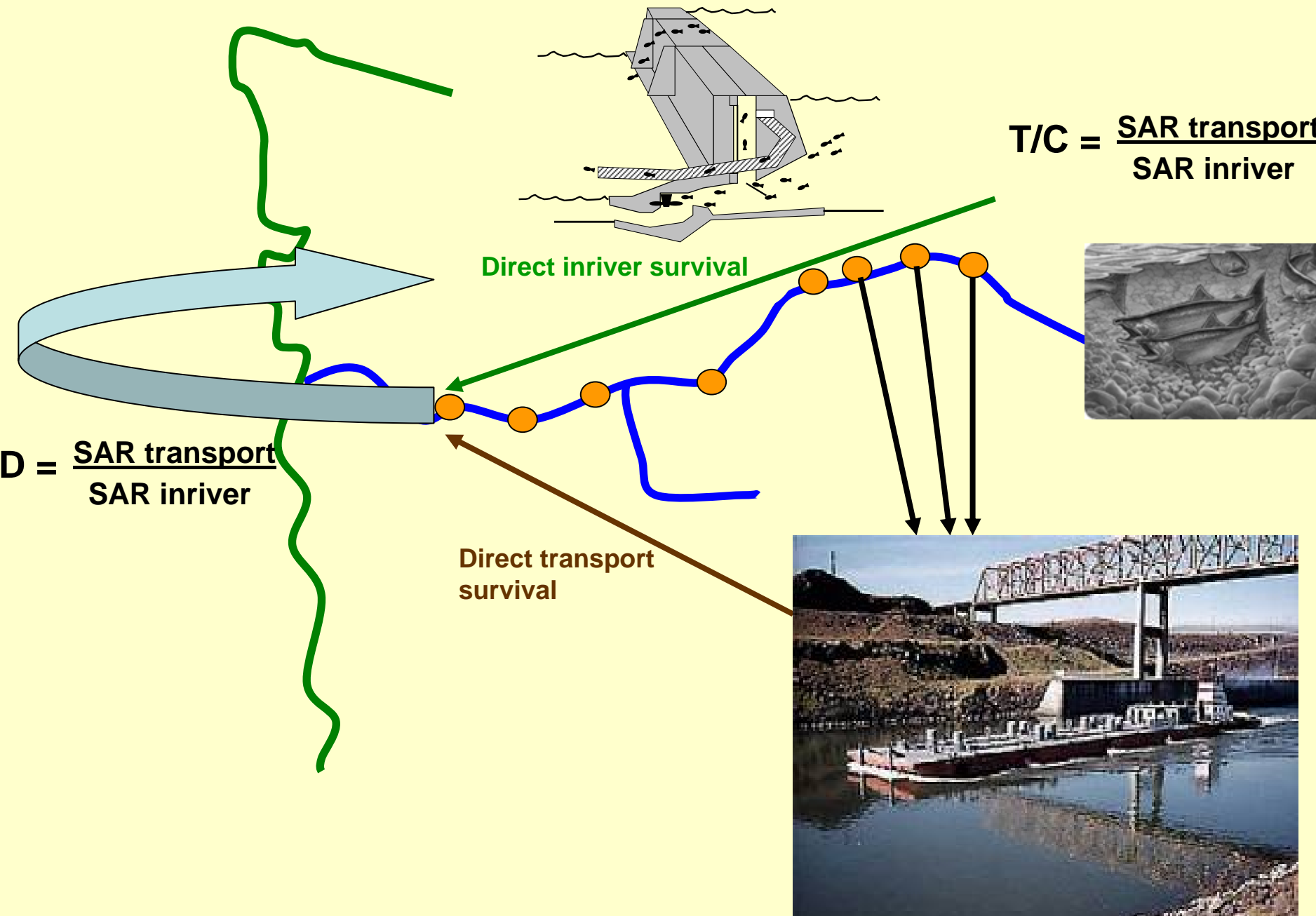 - *address 2005 report comments and responses*

Objectives

- **Develop long-term index of Transport and Inriver survival rates for Snake River Wild and Hatchery spring/summer Chinook and steelhead**
    - *Mark at hatcheries > 220,000 PIT tags*
    - *Smolts diverted to bypass or transport from study design*
    - *Inriver groups SARs from never detected & detected $\geq$ 1 times*
    - *SARs from LGR and Below Bonn for Transported & In-river groups (T/C ratio and Differential delayed mortality-D)*
    - *Increase marks for wild chinook to compare hatchery & wild chinook > 23,000 added wild PIT tagged fish*
    - *Begin marking of steelhead populations in 2003*

- **Develop long-term index of survival rates from release to return**

- **Compare overall survival rates for upriver and downriver spring/summer Chinook hatchery and wild populations**

- **Provide a time series of SARs for use in regional long-term monitoring and evaluation**
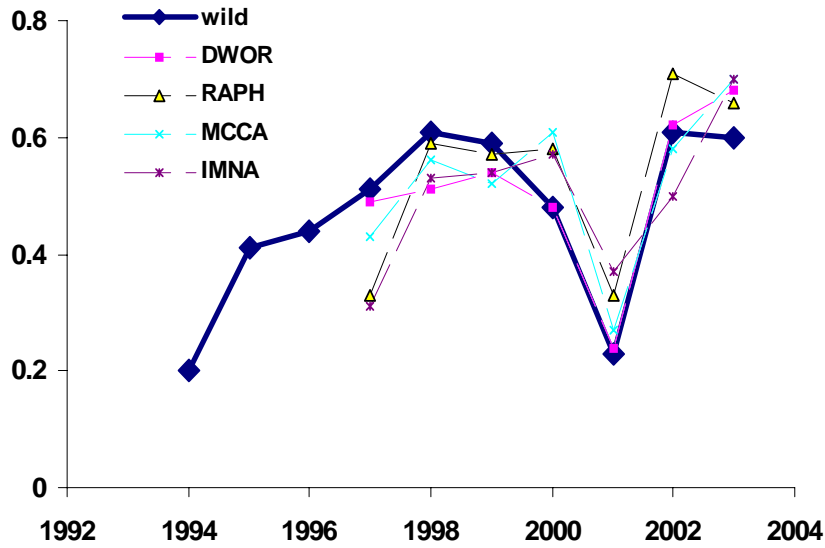
What does CSS project provide?

- **Long term consistent information collaboratively designed and implemented**

- **Information easily accessible and transparent**

- **Long term indices:**
  - *Travel Times*
  - *In-river Survival Rates*
  - *In-river SARs by route of passage*
  - *Transport SARs*

- **Comparisons of SARs**
  - *Transport to In-River*
  - *By geographic location*
  - *By hatchery group*
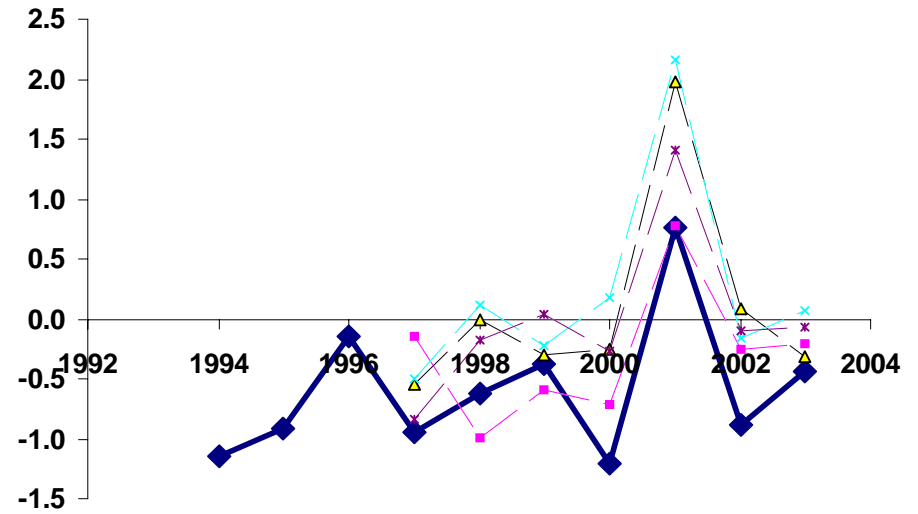 - *Hatchery to Wild*
  - *Chinook to Steelhead*

Survival Rate Estimates
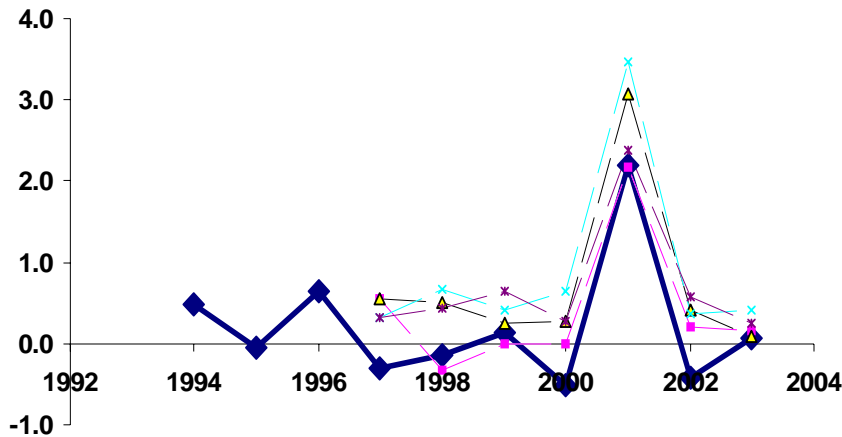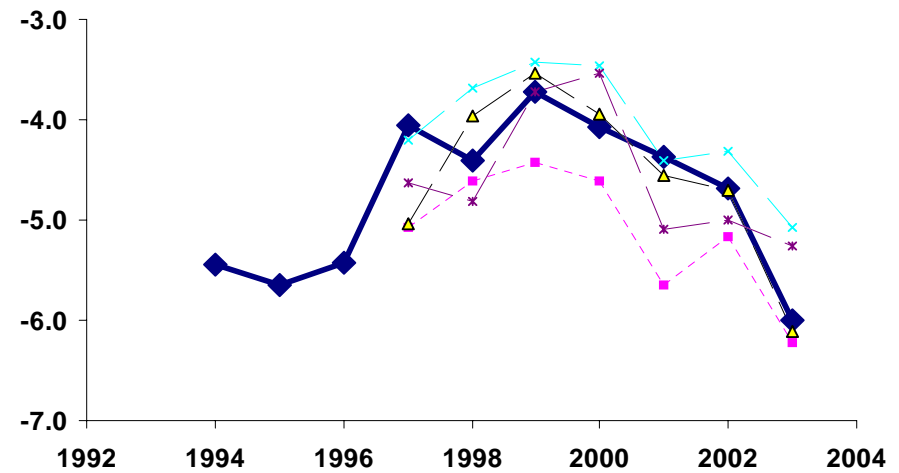

$$T/C = \frac{SAR\ transport}{SAR\ inriver}$$

Direct inriver survival

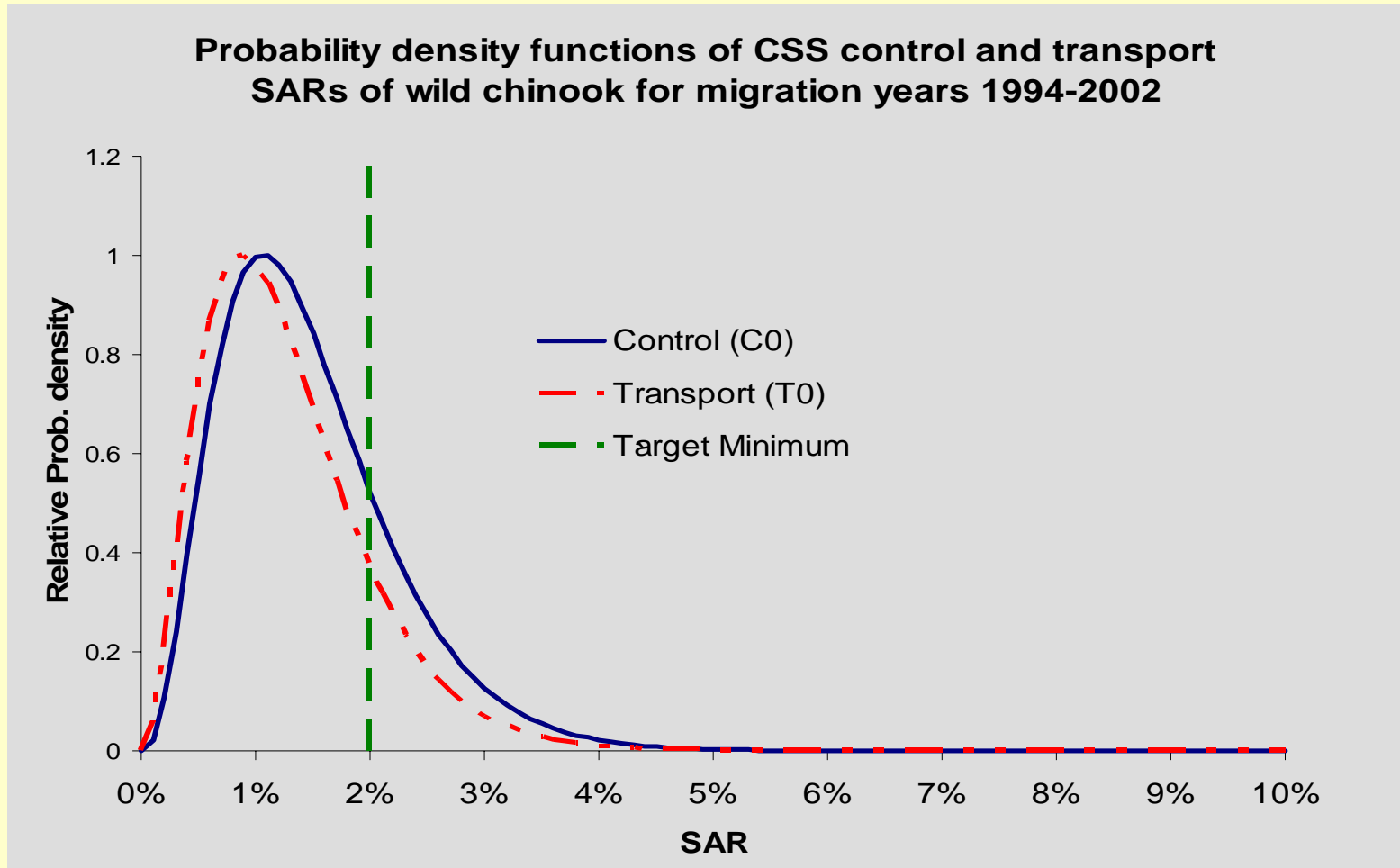$$D = \frac{SAR\ transport}{SAR\ inriver}$$
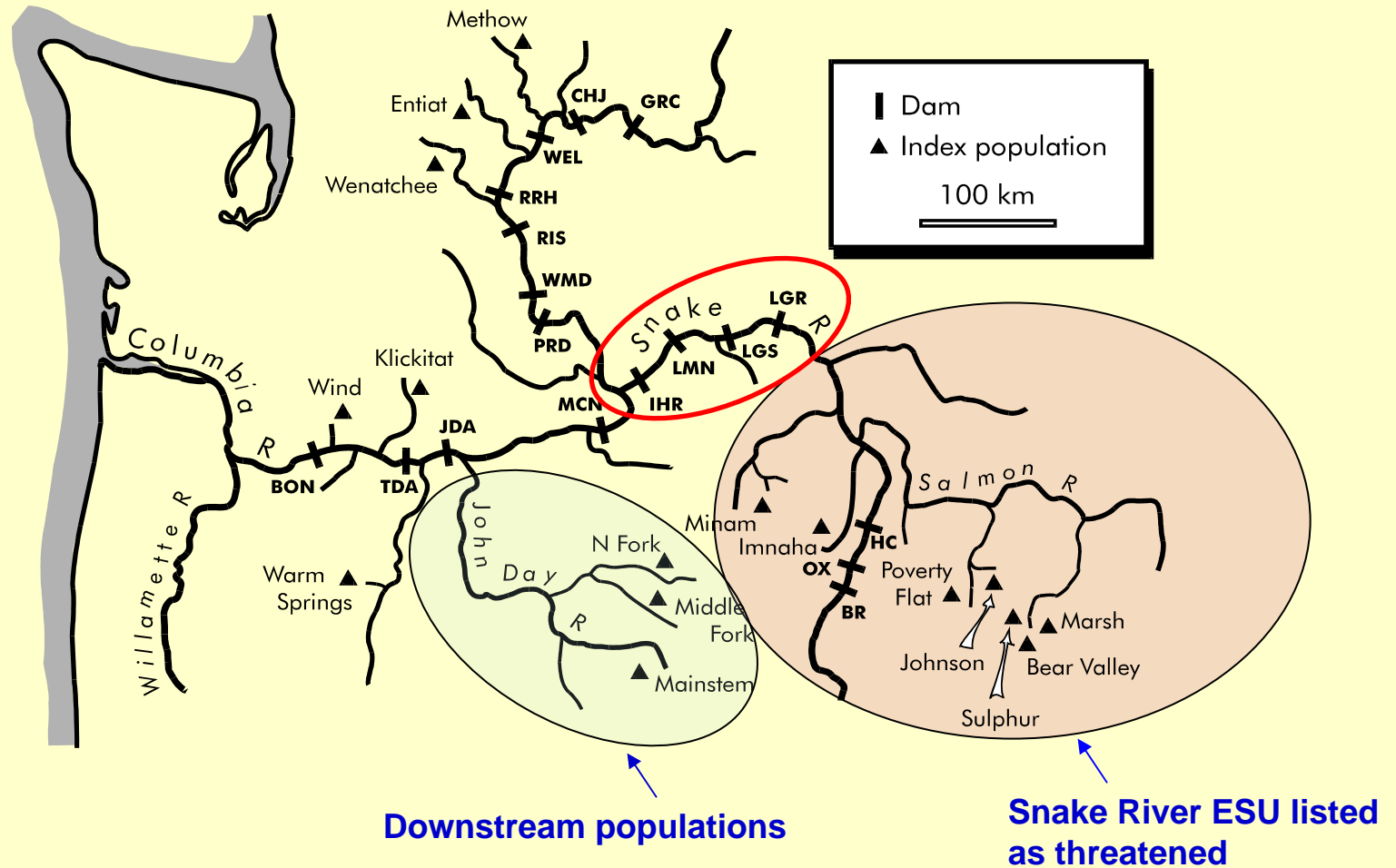
Direct transport survival

Parameter estimates for Snake River wild and hatchery spring/summer Chinook.

# Further analysis: wild Chinook SARs and T/C ratios

- Uncertainty in SARs, T/Cs and Ds due to both process and measurement error
- How to best estimate process error (inter-annual environmental variation) in the true value of these parameters?

Probability density functions of CSS control and transport SARs of wild chinook for migration years 1994-2002

Legend:
- Control (C0) — solid blue line
- Transport (T0) — red dash-dot line
- Target Minimum — green dashed line

X-axis: SAR (0% to 10%)
Y-axis: Relative Prob. density (0 to 1.2)

Snake River salmon declined since completion of the Columbia River Power System

Updated survival rate indices, 1991-1998 brood years

Update of Schaller et al. 1999
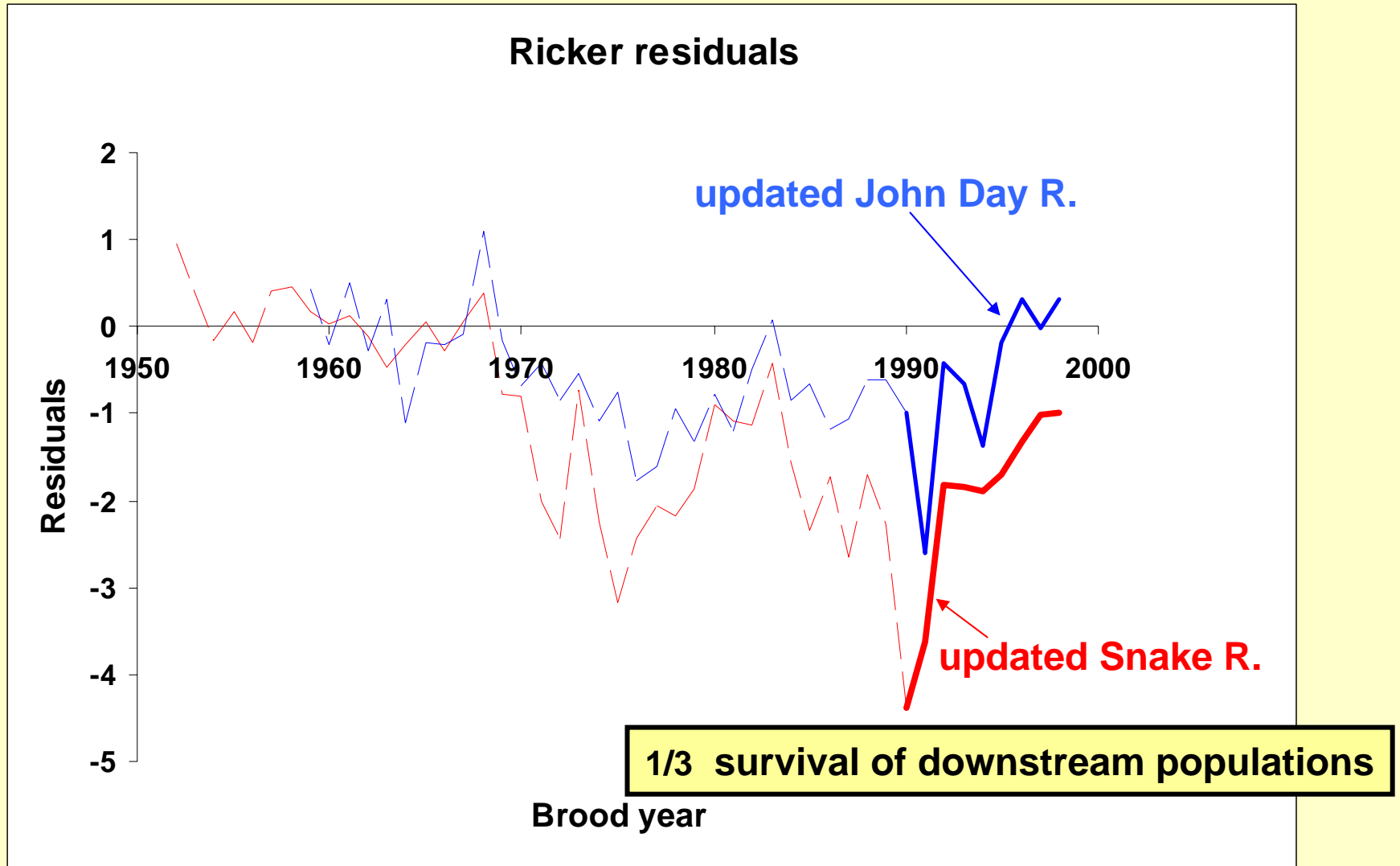
Spawner-recruit analysis:

- Snake River wild Chinook survived ¼ to 1/3 as well as downriver populations since FCRPS completion (Schaller et al. 1999; Deriso et al 2001)

- Common annual mortality patterns between upriver & downriver populations

CSS Objective 3:

- Are SARs for Snake River populations substantially less than SARs of downriver populations?

- Do we see common annual mortality patterns between upriver and downriver populations?

  - Wild and hatchery populations?

Spawner-recruit and SARs:
comparison of differential mortality estimates
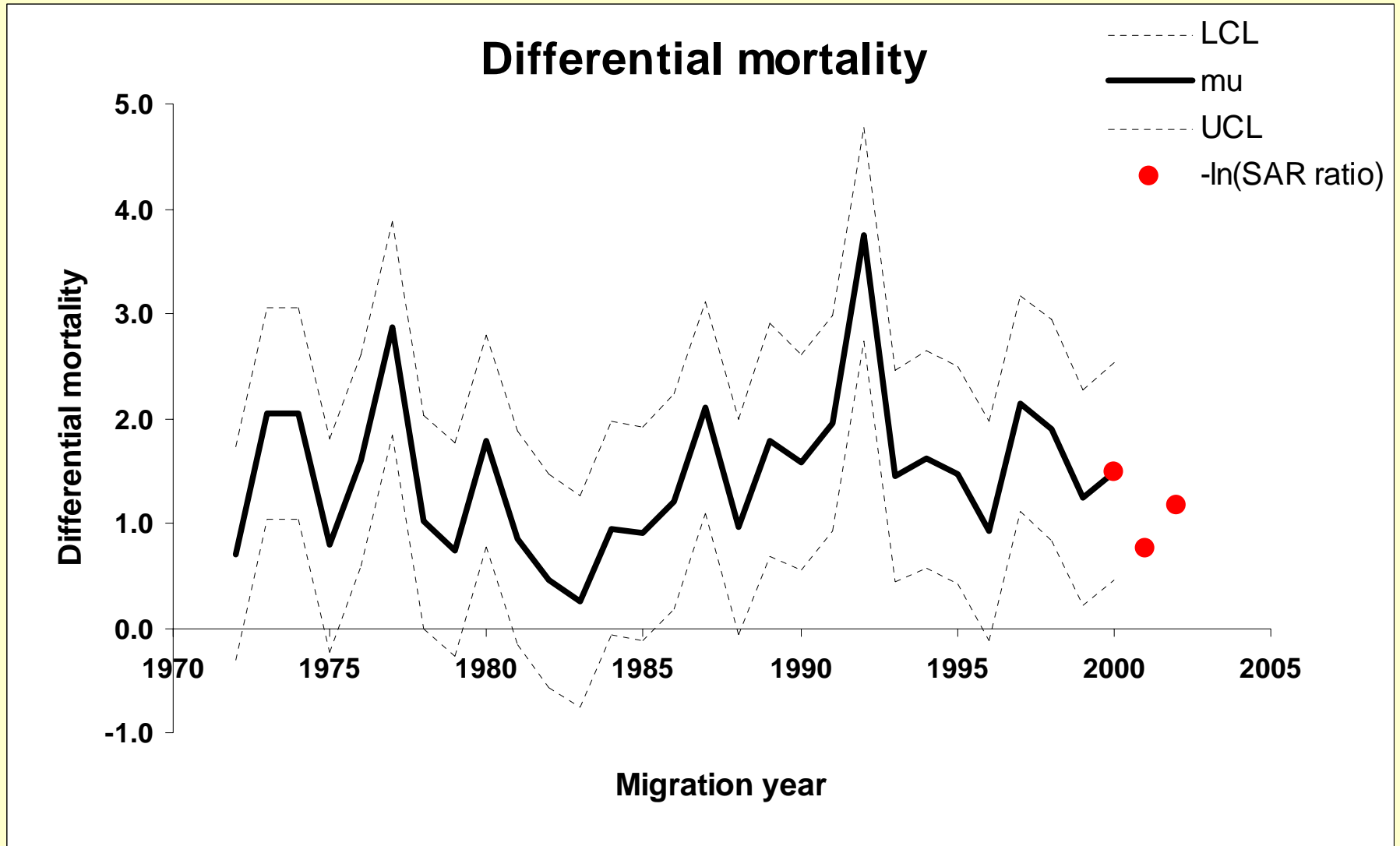
CONCLUSIONS

- **Snake River wild spring/summer Chinook SARs have rarely exceeded the Council's interim biological objective of 2% SAR**

- **Transportation provided little or no benefit to wild Chinook most years, except in the severe drought year of 2001**

- **Transportation provided benefits most years to most groups of hatchery Chinook**

- **Delayed mortality from transportation was evident for both wild and hatchery Chinook (D < 1.0)**

- **Completed simulation model for evaluating CI methods about SARs and SAR ratios**

CONCLUSIONS

- **Differential mortality from wild SARs correspond with estimates from R/S for wild populations**

  - *Deviations in PIT-tag SARs suggest common annual survival patterns during 2000-2002 for Snake River and John Day populations*

- **Differential mortality from hatchery SARs - less than those of wild populations**

- **Wild and hatchery populations differed for some parameters (T/C, D and SARs), though the annual patterns of these parameters were highly correlated**

- **In years of low abundance – Need to rely on hatchery fish**

2006 ISAB Review

- **Conclusions:**
  - **Council should view the CSS as a good long-term monitoring program - results should be viewed with increasing confidence**
  - **Project has received a high level of independent and outside review**
  - **Definitely worth funding**

- **Recommendations:**
  - **Develop a ten year summary report to synthesize evolving methods scattered over numerous annual reports**
  - **Add more downriver sites**
  - **Add analyses - grouping data by environmental and operational factors (amenable to control)**
  - **More attention to including size of PIT tagged fish in analyses**
  - **Test assumptions and methodologies – continue with evaluation through simulation modeling and document results**

CSS - Future Direction

- **Continue to maintain long-term indices of survival for spring/summer Chinook & Steelhead**

- **Expand PIT tag groups for Steelhead (wild & hatchery) and add down river populations**

- **Complete simulation runs to evaluate transport (T_0) and In-river (C_0 and C_1) SAR estimates and confidence intervals from bootstrapping**

- **Develop distributions for SARs, T/C, and D**

- **Further work on seasonality effects is planned for inclusion in CSS:**

  - *Develop technique to estimate seasonally blocked SARs and confidence intervals*

  - *Evaluate seasonality over series of years for consistent patterns in SARs, T/Cs and Ds*

- **Develop ten year summary report of CSS project**