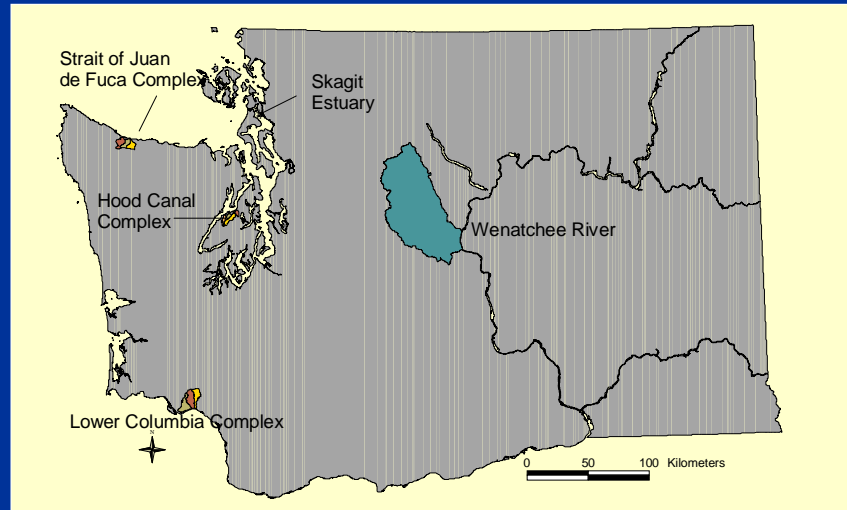


## Intensively Monitored Watersheds: Expectations from Long-term Monitoring

### Questions

- Can habitat restoration, as currently implemented, increase outmigrant production?
  - *Short-term*-changes to habitat or local fish abundance
  - *Long-term*-increased outmigrant production
- Can we use this information to guide restoration?

## Intensive Watershed Monitoring Study Locations



## Design

- Before-After/Control-Impact
- Hierarchical monitoring scheme at different spatial scales
  1. *Reach scale*-effects of specific restoration action
  2. *Sub basin scale*-effects of multiple restoration actions
  3. *Basin scale*-effectiveness of all actions

## Baseline

- **Smolt production**
- Spawner counts and distribution
- Summer juvenile abundance
- Habitat
- Flow
- Water quality

## Expectations

1. What magnitude of change can be detected?
2. When will results be available?
3. What will it cost?

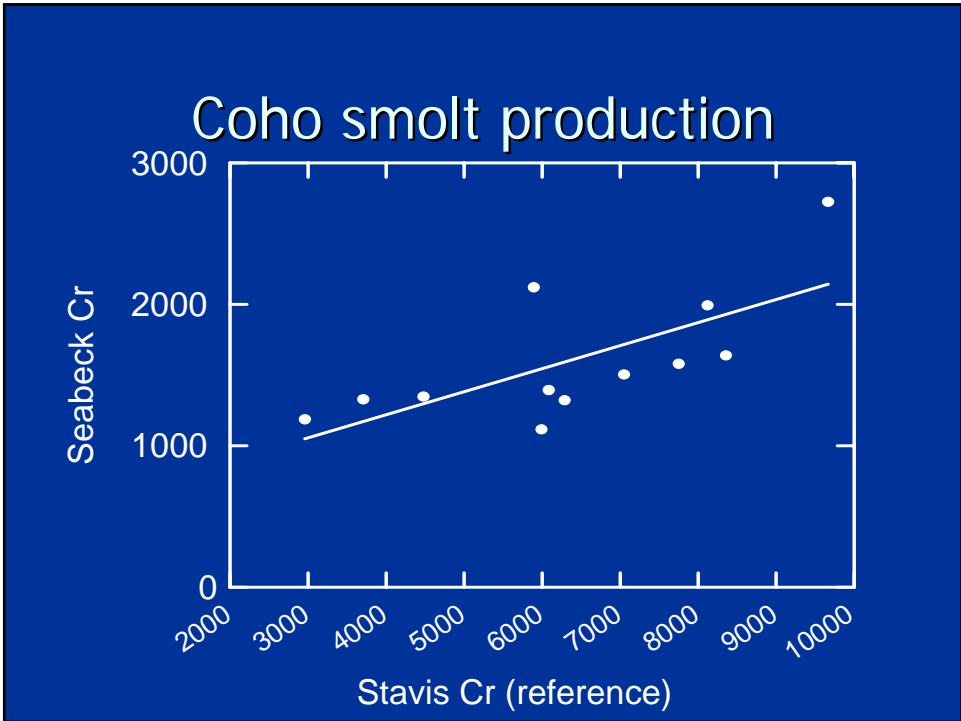
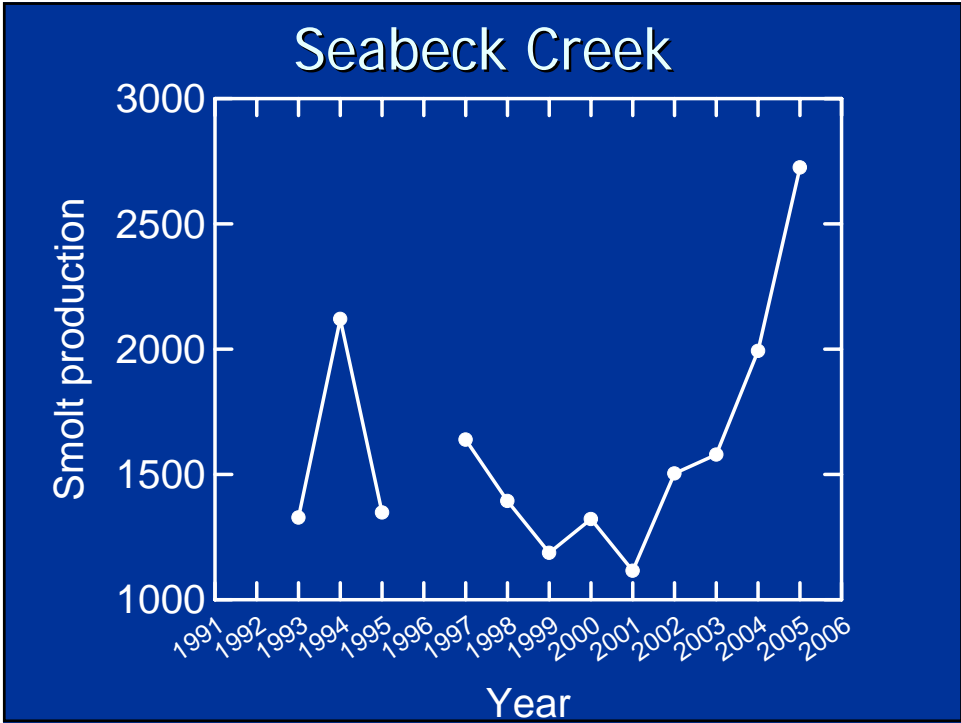
## Power Analyses

- Using existing data to estimate variance
- Three scenarios:
  - No reference (non significant relationship)
  - BACI-Treatment vs reference regression
  - BACI-regression with covariates

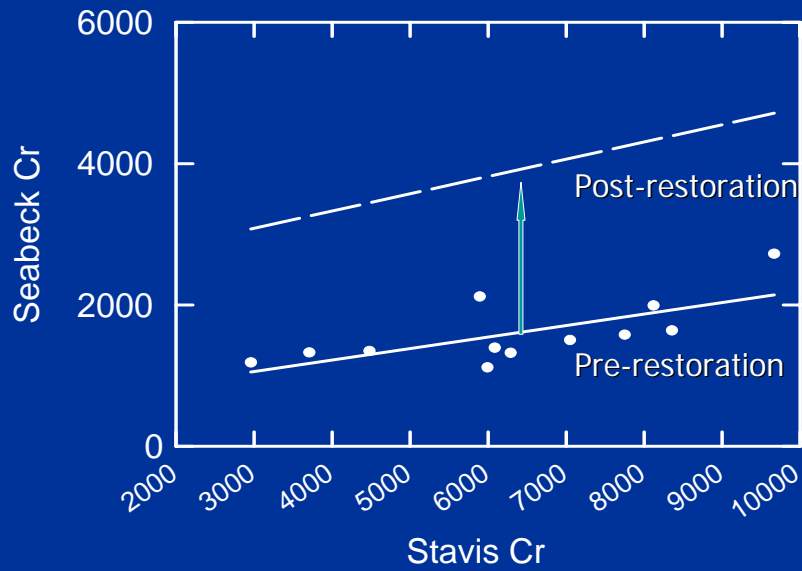
### Two sample t-test

$\alpha = \beta = 0.10$ , power = 0.90

$$\Delta P = \sqrt{\frac{2s^2 (t_{1-\alpha} + t_{1-\beta})^2}{n}}$$



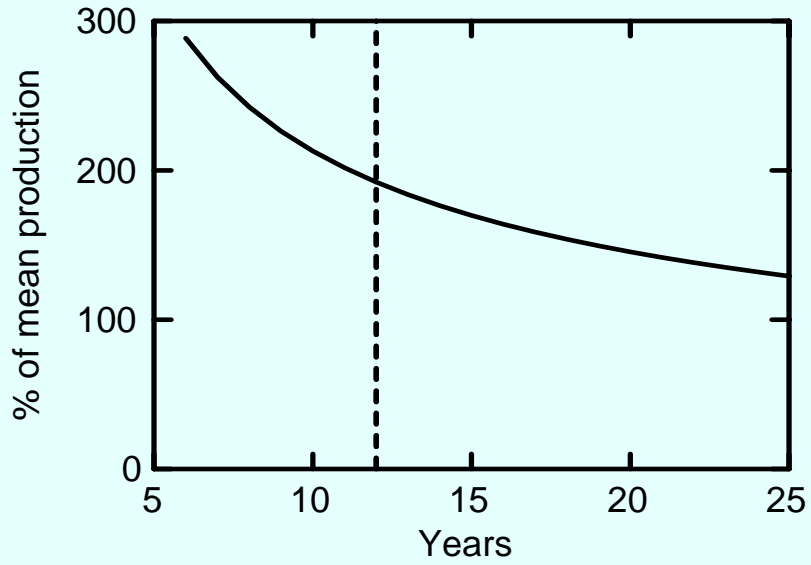
## Change in intercept



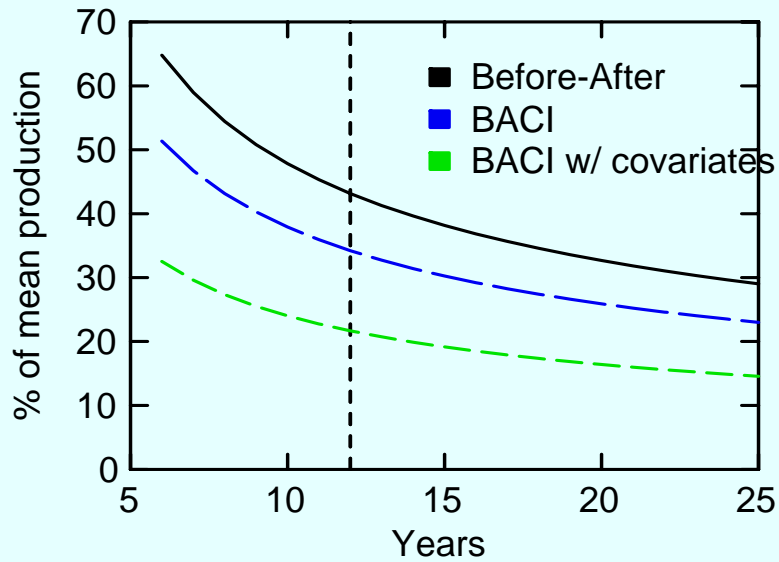
## Assumptions

- Fish response time not included
- Pre-restoration  $\sigma^2$  = Post-restoration  $\sigma^2$
- Change in intercept, not slope

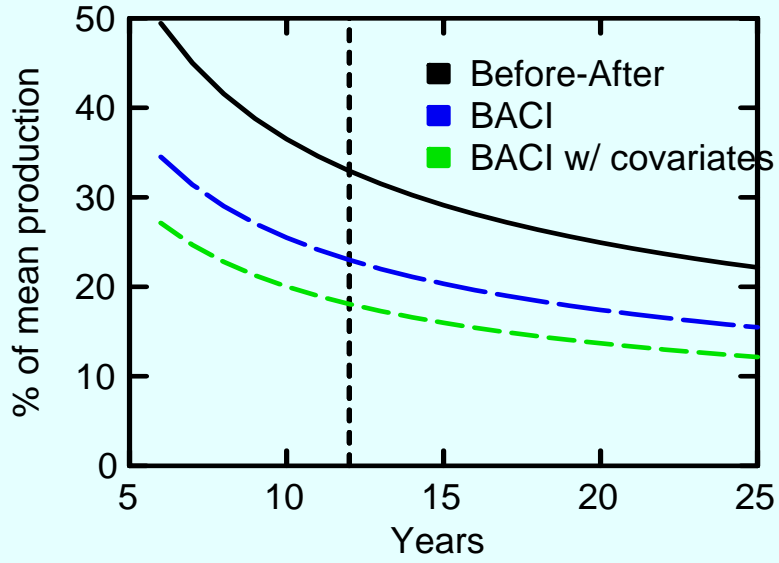
## Little Anderson Cr-minimum $\Delta P$



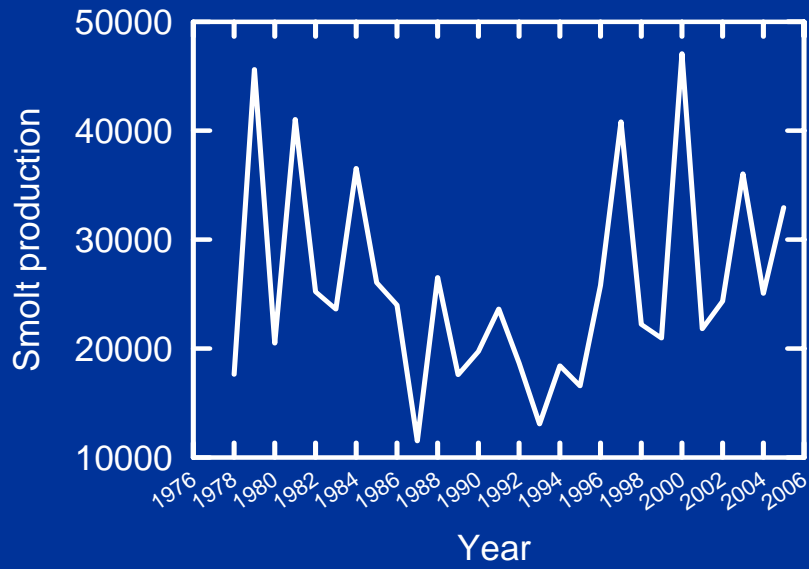
## Seabeck Cr-minimum $\Delta P$



## Big Beef Cr-minimum $\Delta P$



## Big Beef Cr





## Conclusions

- Well-designed monitoring program can detect relatively small (20-40%) increases in smolt production
- Understanding why is critical to differentiate between restoration impacts and other

## IMW Program Participants

### State Agencies

- Washington Dept. of Ecology-Bill Ehinger
- Washington Dept. of Fish and Wildlife-Tim Quinn, Greg Volkhardt

### Federal Agencies

- NOAA Fisheries (NWFSC)-Phil Roni, Correigh Greene

### Tribes

- Lower Elwha Klallam Tribe-Mike McHenry
- Skagit River System Coop-Eric Beamer

### Private

- Weyerhaeuser-Bob Bilby