## Escapement and Proportion of Natural Origin Salmonids Contributing to Total Escapement

**Hypothesis:** If numbers of naturally produced juvenile salmonids increase in response to improved habitat conditions in the Trinity River, escapement to natural areas of the river and proportions of natural origin (naturally produced) salmonid spawners will increase compared to hatchery produced spawners, given constant or reduced hatchery production.

**Importance:** This performance measure informs TRRP of proportional (or percent) escapement trends and changes between escapement of natural origin (naturally produced) salmonids compared to hatchery produced stocks. We predicted in the Integrated Assessment Plan (TRRP 2002) that modified flows and channel rehabilitation actions should increase juvenile salmonid rearing habitat capacity and therefore increase the quantity and quality of naturally produced juvenile out-migrants. We also predicted an increase in natural juvenile production would later contribute to an increase in naturally produced salmonid spawner escapement. The increase in naturally produced spawners can be observed as a proportional increase compared to hatchery spawners given constant hatchery production.

**Targets, Predicted or Desired Response:** We assume an increasing trend in escapement and the percent of naturally produced spawners are related to increased natural juvenile survival in response to improving river conditions. We predict that the proportion of natural salmonids in the total run will increase as the rehabilitation of the Trinity River increases juvenile habitat carrying capacity. Upon ocean entry, both natural and hatchery smolts are assumed to experience the same ocean environmental conditions and survival rates. This performance measure provides support to the hypotheses that modifying flows combined with channel rehabilitation actions should increase the proportions of natural to hatchery salmonids in the Trinity River.

Technical Approach: This performance measure is developed based on the following parameters:

- Upon ocean entry, both natural and hatchery smolts are assumed to experience the same ocean environmental conditions and survival rates;
- We assume an increasing proportional trend in natural spawner escapement is related to improving river conditions;
- Escapement estimates for spring- and fall-run Chinook and coho salmon, and for fall-run steelhead are determined by mark-recapture methods;
- Estimated number of naturally produced and hatchery produced fish in each run (see Kier et al 2015);
- These data were plotted over time to examine the proportional relationship for naturally produced and hatchery produced fall- and spring-run Chinook and coho salmon and steelhead;
- If the hatchery produces similar numbers of yearlings and fingerlings in similar health and condition every year, any change in the ratio of natural to hatchery salmonids is hypothesized to be due to changes in the natural population;
- ROD flows began in 2005 which likely had an immediate effect on natural production; and
- Simple linear regression (P=0.05) used to test for significant trends over time.

**Results:** The escapement and proportion (percent) of naturally produced spawners are shown in Figures 1-4. Steelhead show the strongest and significant (P>0.05) increasing trend of percent increase in natural production over the periods shown. They also spend the most time juvenile rearing in the river which may reflect a positive response to an improvement in juvenile rearing conditions. Since 2007, naturally produced

spring and fall Chinook also show a general increase in percent of production compared to 2001-2005. Naturally produced fall Chinook salmon were above 50% of the total fall Chinook spawners six of the eight years since 2007 and only above 50% once in the previous five years 2001-2006. Naturally produced coho salmon have not shown a trend over the periods shown, but have increased since 2009.



Contact: Mary Claire Kier, maryclaire.kier@wildlife.ca.gov, CDFW Arcata, 707-822-5876

**Figure 1.** Estimated escapement number (left axis) and percent (right axis) of naturally-produced adult spring Chinook salmon returning to the Trinity River above Junction City, 2001-2014. No significant trend detected (P>0.05).



**Figure 2**. Estimated escapement number (left axis) and percent (right axis) of naturally-produced adult fall Chinook salmon returning to the Trinity River above Willow Creek, 2001-2014. No significant trend detected (P>0.05).



**Figure 3.** Estimated escapement number (left axis) and percent (right axis) of naturally-produced adult coho salmon returning to the Trinity River above Willow Creek, 2001-2014. No significant trend detected (*P*>0.05).



**Figure 4.** Estimated escapement number (left axis) and percent (right axis) of naturally-produced adult steelhead returning to the Trinity River above Willow Creek, 2001-2014. A significant increasing trend detected (P<0.05).