

## Summary information on 2008 Southern Resident Killer Whale births and deaths

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### **Background**

The Southern Resident Killer Whales are a small (typically 80-90 animals) population of killer whales that range from the Queen Charlotte Islands in British Columbia to Monterey, California. They spend a considerable amount of the summer time in the San Juan Islands and Puget Sound areas, feeding mostly on Chinook salmon.

### **What are typical birth and death rates for the whales?**

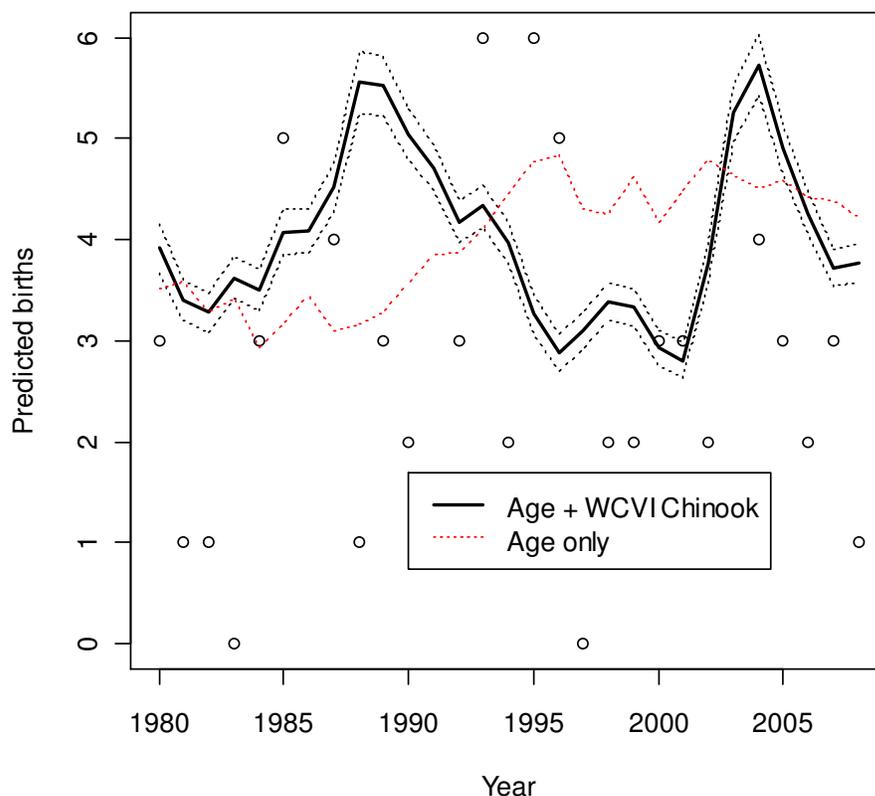
**Births:** Over the last three decades, 99 whales were born and counted as part of the survey (average of 3.3/yr). Of these individuals, 82% (or 81) survived beyond their first year. As some calves might be missed due to dying before being counted, this is a slightly optimistic survival rate.

**Deaths:** Over the last thirty years, the Southern Resident population has included 183 unique individuals. Since 1978, there have been 98 deaths (average 3.25 / yr). For a population of 90 individuals, this represents about 3.6% of all whales. Killer whales experience age-specific survival: mortality rates are generally highest among young calves, and lowest among reproductive age females. Like humans, survival is sex-specific - male killer whales have higher mortality rates (and decreased life expectancy), compared to females.

### **How do the number of births and deaths in 2008 compare with what is expected?**

**Births:** Only 1 calf that survived to at least six months was observed in 2008, which is lower than the expected number of ~3-4 based on the age structure of the population and the 2007 abundance of Chinook salmon off of West Coast Vancouver Island (Figure 1). However, there have been previous years with only 1 or no births.

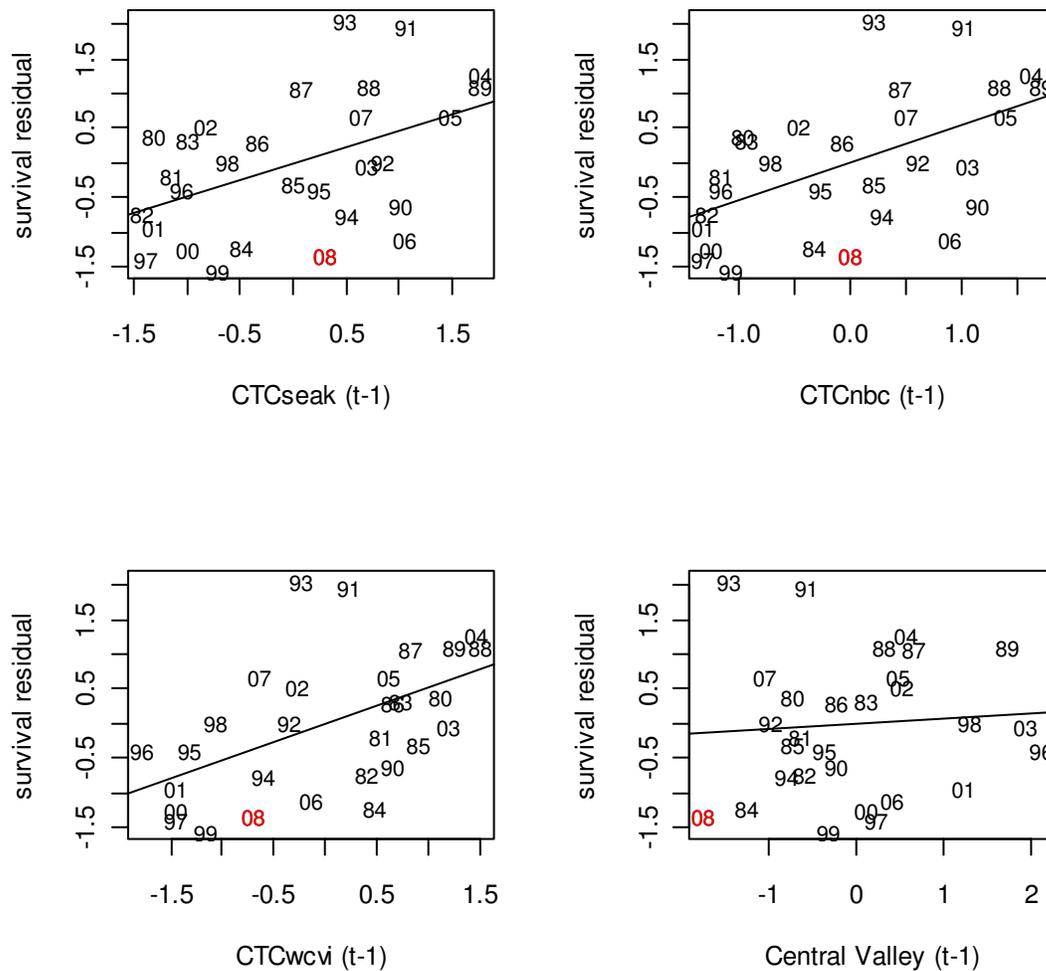
**Deaths:** There were a total of seven deaths in 2008, although two of these were calves that by convention would not have been counted as part of the population at the time they died. High calf mortality is not considered unusual. The mortalities include: Calves (2): J43 was a fall 2007 calf and L111 was a summer calf – neither of these would have been included in the annual 2008 census. Old females (2): K7 and L21, approximately 98 and 56 yrs old, respectively. Mortality in this age group is not surprising. Reproductive females (2): J11, a 35 year old and L67, a 32 year female. It is more unusual to see mortality among reproductive females, particularly two in one year. Sub-adults (1): L101, a 5 year old male. Mortality in this age class also tends to be low. It is possible that L101's death was related to L67 being ill.



**Figure 1 Model predicted mean births / year for the Southern resident killer whale population. Dotted black lines represent 95% confidence intervals, circles represent observed births, and the red line represents the model without Chinook salmon as a predictor, to reflect the changing age structure of the population.**

**What factors influence how many births and deaths occur?**

Several studies have looked at a variety of factors to try to explain annual variability in the whales' birth and death rates. In addition to age structure of the population, salmon abundance is correlated with both births and deaths, with higher salmon abundance leading to on average higher birth rates and high survival (Figures 1 and 2). The pattern of correlation is complicated, however, and not all salmon stocks contribute equally to the pattern. Salmon abundance in the ocean off of the west coast of Vancouver Island (predominately Fraser River, Puget Sound, and Columbia River fall Chinook stocks) are most strongly correlated with fecundity (Figure 1), and ocean abundance in this area as well as more northern areas are most strongly correlated with survival (Figure 2). Although 2007 (and 2008) were characterized by low abundance of Central Valley Fall Chinook salmon, the whale survival has not been strongly correlated with this salmon stock (Figure 2).



**Figure 2. Indices of PSC and Central Valley Chinook (lagged 1 year) versus standardized residuals of the survival model. The west coast Vancouver Island (WCVI) index is the most representative of the 3 PSC indices – while the 2008 index is low, it is not the worst on record (late 1990s).**

### **Do we know for sure what the whales eat?**

Studies over a number of years indicate that at least during the summer months the whales eat mostly salmon. By sampling the remains of prey after feeding events as well as analysis of fecal samples, Chinook salmon appear to make up >80% of their diet during the summer months. Genetic analysis indicates that the dominant stocks consumed are from the Fraser River, and include spring, summer and fall run stocks. Chinook salmon from Puget Sound, southern British Columbia and Vancouver Island are also found in their diet. After Chinook salmon, the next most common salmon in their diet is chum salmon, which they eat particularly in the fall in Puget Sound. Their diet when they are on the outer coast in the winter is unknown. Based on limited observation

of the whales' behavior in coastal water and chemical analysis of biopsy samples, however, it appears likely that they are preying on salmon in coast waters as well.

### **How did Chinook salmon abundance in 2007 and 2008 compare with previous years?**

Summary: Southern (Sacramento Fall run and Klamath age-4) were at record or near record low abundance in 2007 and the Sacramento Fall run was predicted to be at very low abundance in 2008. Columbia River fall run stocks were also lower than average, and typical of what they were in the mid-1990's. Interior Columbia spring and summer runs were higher than average. Puget Sound stocks were somewhat above average in 2007 and predicted to be higher than average in 2008. Fraser River stocks of stream type spring and summer Chinook salmon were at recent record low abundance in 2007. Preliminary estimates are that the 2008 return may be slightly higher than 2007.

Details:

- Pacific Salmon Commission ocean abundance indices (Feb 2008 CTC Chinook report)

The CTC has several indices of Chinook salmon ocean abundance, some of which are correlated with Southern Resident Killer Whale fecundity or survival. For 2007, the West Coast Vancouver Island index (primarily fall runs from the Fraser River, Puget Sound, and Columbia River) was somewhat (but not unusually) below normal (0.67 compared to a 1979-2007 average of 0.83) (Figure 2). The other two major indices (Northern British Columbia and Southeast Alaska) were either average or above average (Figure 2).

Fraser: Spawning escapement of stream type spring and summer Chinook totaled less than 23,000 in 2007. This was the lowest return in more than 20 years. Preliminary estimates of the 2008 return are 32,600, which is the second lowest escapement in recent years. The run of ocean type Chinook in the Fraser has been increasing, but these fish migrate to the north and return primarily through the Strait of Georgia and therefore may not contribute much to the whales diet.

- Pacific Fisheries Management Council escapement and ocean abundance estimates (2008 February pre-season report, available at <http://www.pcouncil.org>. Note that many of these are escapement or terminal run size estimates, and may not be very reflective of the abundance that was available to the whales.

Puget Sound: The 2007 return to Puget Sound (excludes fish caught in Puget Sound troll and recreational fisheries) was above average (187,200, compared to an average since 1993 of ~178,000). The 2008 forecast is above average (224,600).

Interior Columbia River spring and summer run: The Bonneville Dam counts for spring Chinook in 2007 were below average (66,624 compared to an average since 1980 of 101,607). The counts for 2008 are above average (125,545). Summer run counts were above average in 2007 and 2008 (47,882 and 78,271, respectively, compared to an average since 1980 of 41,465).

Columbia River Fall stocks (Upper River Bright, Lower River Wild, Lower River Hatchery, Spring Creek Hatchery, Mid-Columbia Brights): 2007 escapements were below average (211,000 compared to an average since 1990 of ~394,000). Predicted 2008 escapement was about average (366,500).

Klamath River: Ocean abundance of age-4 Klamath Chinook was a third of average in 2007 (32,500 compared to an average since 1981 of 98,985). Ocean abundance of age-3 was well above average (521,400 compared to an average of 368,500). In 2008, age-3 are expected to be well below average (31,600) and age-4 are expected to be above average (157,200).

Sacramento River: Sacramento River fall Chinook salmon were at near record low abundance in 2007 and were predicted to be a very low abundance in 2008. The Central Valley Index (ocean landing + escapement) was 232,000 in 2007, compared to an average since 1970 of ~703,000. The prediction for 2008 was 157,100, the lowest on record (Figure 2).

### **Did the whales look or behave differently from normal this year?**

Reports by the Center Whale Research indicate that for the past two years the whales spent less time than normal in the San Island area, and, when present, tended to be more spread out across the water. This type of behavior has been hypothesized to be related to low salmon densities and seems consistent with the lower than average Fraser River spring and summer Chinook returns.