Table 2 (*concluded*).

Hatchery	Estuary	Status	Chinook PAHs (stomach)	Chinook PCBs (stomach)	Chinook PCBs (liver and whole body)	Chinook Other data	Other species ($ng \cdot g^{-1}$)	Toxic sediment	Listed sites and contaminants of concern	References*
Garrison	Chambers Bay	C						ND	Narrative	
Minter Cr	Henderson Bay	UC						NT, 1	Used as reference site	6, 13, 14

Note: Status denotes estuary as contaminated (C) or uncontaminated (UC). For fish concentrations, fillet refers to a fillet with skin on, and stomach refers to stomach contents. Other species include English sole, clams, and crabs. All Chinook values are from composites of several individuals. All concentrations are recorded as wet mass. Juvenile Chinook from Soos Creek, Puyallup, Kalama Creek, McAllister Creek, and the Wallace River hatcheries were used to determine mean values for all hatcheries. Values followed by the multiplication sign are the factor differences between hatchery and estuary values for fish and were determined by dividing the mean + 1 standard deviation (determined for the site) by the hatchery mean value. *n* is sample size. Values for Shilshole are from samples taken in the estuary downstream of the locks. Toxic sediment shows the results of toxicity bioassays conducted in estuaries or nearby (Tox, toxic; NT, not toxic). Also in this column are values indicating pass or fail for sediment concentrations compared with ERM values (effects range–medium) (Long et al. 2003) and WA State Sediment Standards (1, full pass; 2, fail SQS; 3, fail CSL; 4, fail ERM; 5, fails two of three; 6, fails all three). Listed sites include Puget Sound Initiative (PSI) and Washington Department of Ecology sites designated for cleanup and source control because of contamination; CU denotes the number of such sites for a given estuary. Also shown are estuaries used as control or reference (ref.) sites. CoC lists contaminants of concern occurring at elevated concentrations. ND, no data; BD, below detection. See text and Supplementary data[1] for details.

*References: (1) D. Houck, personal communication, 2011; (2) Varanasi et al. (1993); (3) Meador et al. (2010); (4) Long et al. (2000); (5) Long et al. (1999); (6) Long et al. (2002); (7) Norton (1999); (8) USEPA (1988; (9) Cubbage (1991); (10) Norton (1986); (11) Era-Miller 2004; (12) McCain et al. (2000); (13) Long et al. (2003); (14) PTI (1991). PSI sites from Washington Department of Ecology (2012).

†Superfund site.

‡Data from Kerwin (1999).

indicated that survival was higher for Chinook transiting uncontaminated estuaries for 28 out of 32 years ($p < 0.0001$) (Table 5). When compared year by year, the mean difference in survival for Chinook transiting uncontaminated estuaries was 2.5-fold higher ($n = 32$ years) and for coho was essentially neutral (0.98-fold) ($n = 36$) (Table S1[1]). The Wilcoxon test for fish mass at release returned a *p* value of 0.25, also indicating no pattern among years. The Chinook SAR over years as grouped by estuary contamination status is highlighted in Fig. 2. For the past 10 years (1998–2008), the SAR was on average 2.1-fold higher for fish transiting uncontaminated versus contaminated estuaries (Table S1[1]).

The regression between SAR and release mass for Chinook over all tag code groups indicated a weak relationship ($R^2 = 0.03$, $p = 0.002$, $n = 390$), which was also observed when analyzed separately by contamination group. A similar result was obtained when all tag code groups ($n = 290$) were included from 1985 to 2008 ($R^2 = 0.01$, $p = 0.09$). The regression between the SAR and release DoY for all tag code groups ($n = 390$) in this time period exhibited a low *p* value ($p < 0.001$); however, the R^2 (0.08) was too low to be predictive. A regression with all qualifying tag code groups ($n = 57$) for the same years as those analyzed by Duffy and Beauchamp (2011) yielded a relatively strong negative correlation (log SAR = $-0.134 - 0.015 \times$ DoY; $R^2 = 0.38$, $p < 0.001$), which supports the importance of this factor for select time periods.

A generalized linear model (GLM) was constructed with Chinook SAR as the dependent variable and release mass and DoY as independent variables using all tag code groups ($n = 390$). The overall model exhibited a low *p* value ($p = 0.002$) using only DoY due to the large sample size. The Akaike information criteria (AIC) changed less than 1.7% for each parameter added (release mass and the interaction term), and the R^2 was always below 0.1 for all models, indicating that these parameters explained only a low percentage of the SAR variance. This was expected, given the high degree of interannual variation.

The ANOVA for survival among coho for all years and hatcheries exhibited a low *p* value ($p = 0.07$) because the rate of survival was slightly higher for fish transiting contaminated estuaries (6.9% versus 8.1%, $n = 226$) (Fig. 3; Table 5). However, when compared year by year ($n = 36$), the mean for differences in survival was 0.98, indicating no difference overall even though the data were variable (Table S2[1]). The release masses for coho were on average larger (26.1 versus 25.0 g) for fish from contaminated estuaries ($p = 0.05$), although regression analysis for all years determined no relationship between release mass and SAR ($R^2 \approx 0$). The Wilcoxon analysis by year indicated that for most years (23 of 36 years), coho SAR values were on average higher for fish that outmigrated through a contaminated estuary (Table 5). A similar pattern was observed for coho release masses (Table 5). Without coho data from the Wallace Falls hatchery, the difference in SAR values between contaminated and uncontaminated estuaries was greatly reduced (ANOVA $p = 0.34$, Wilcoxon $p = 0.12$), indicating that this hatchery exhibited a strong influence on the results. Without including that hatchery, the differences for fish release mass did not change, as the overall mean increased slightly to 26.6 g for coho transiting contaminated estuaries.

The Chinook data were examined to determine whether any hatcheries may have had an undue influence on their respective group. The results clearly show that among the hatcheries where fish entered an uncontaminated estuary, one hatchery (Portage Bay) stood out because of its very high rate of survival (Table 3). This hatchery contributed data for only 6 of the 37 years and was restricted to the early 1970s, 1981–1982, and 2001, so its influence on the overall pattern was minor. Kendall Creek also exhibited unusually high survival, but only for the early 1970s. These high survival values overlapped with other hatcheries also exhibiting high survival in the 1970s and early 1980s, including Samish and Soos creeks. For Portage Bay and Kendall, no survival values exceeded 2.0% after 1979, except for Portage Bay in 2001. The ANOVAs