

Southern Resident killer whales with anomalous growth, 2022/2023

Holly Fearnbach and John Durban

SR3, SeaLife Response Rehabilitation and Research; hfearnbach@sealifer3.org

Rational. In 2018, a 3-4 year old Southern Resident killer whale (SRKW), J50, died after our photogrammetry research measured her declining body condition and estimated her body length to be anomalously small for her age. This emphasized that patterns of growth, in addition to quantitative measures of body condition, may be useful for identifying constrained health.

Sample Data. We estimated body length for all 12 whales in the SRKW population that were under 10 years of age, and therefore in a key phase of early growth, between September 2022 and April 2023 (J51, J53, J56, J57, J58, J59, K45, L121, L122, L123, L124, L125). Standard drone photogrammetry methods were used, specifically an octocopter platform (Durban et al. 2022) to carry a digital camera with full frame sensor (7360 x 4912 pixels), a 55mm lens long enough to ensure a flat and undistorted image and a precise laser-altimeter to estimate scale (Groskreutz et al. 2019).

Identifying anomalously small whales. Length estimates for these 12 young whales ranged from 2.91 m for K45 in the first year of her life to 5.19 m for L122 in his eighth year. These were included in a larger dataset of 340 lengths for 82 known-age SRKWs measured from drone photogrammetry in 2017-2022, all estimated with the same precise laser altimeter for scale. Importantly, this expanded dataset contained 82 length-at-age measurements from 26 different whales under the age of 10. We fit a Bayesian formulation of the Richards growth curve (Fearnbach et al. 2011) to the length-at-age data and used a mixture formulation (Hoeting et al. 1996) to specify a heavy-tailed residual distribution of measurements around sex-specific growth curves to allow for outliers. One whale (J53, a female in her eighth year of life) from these 12 whales had high probability of being a negative outlier, with $p(\text{outlier})=0.75$ and a residual of -0.49 m smaller than expected for her age. This contrasts with three more recent calves (J57, J58 and J59, ages 2.6, 2.5 and 1.2 years) with positive residuals of 0.57, 0.56 and 0.63 m and all with $p(\text{outlier})>0.90$. Of note, J53 has had a high probability of being below the growth curve in every year since her mother died in 2019, leaving her orphaned in her fourth year of life. A second whale, L123, was identified as an anomalously small outlier in our previous 2021/2022 report with a negative residual of -0.68m. In 2023/23 this residual had declined to -0.19 m and fell within the normal distribution around the average male growth curve. L123 is the first calf of L103 and has been a negative outlier in 3/6 years since 2017; his recent improvement in growth shows the power of this approach for detecting changes.

References

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