

Final Definition provided by FMWG CAP DES Juvenile Outmigrant Refinement Define Smolt Equivalent Task Group to StreamNet.

Appendix G. An Explanation of the Term "Smolt Equivalents" As Used By the Coordinated Assessments Partnership

"Smolt equivalents", a term used in the JuvenileOutmigrants table, is a concept used to standardize outmigrant numbers from one or more locations and/or juvenile life stages to a single location at the smolt life stage.

The simplest example is an estimate made within a population's boundaries for just the smolts at one trap. Umatilla River steelhead juvenile monitoring at Threemile Falls Dam is an example – emigrant numbers are estimated using a trap at the juvenile bypass facility on the dam. In this case all emigrants passing the trap are considered smolts due to the migration timing, location of the trap, and physical evaluation of juveniles for smolt characteristics at the juvenile bypass facility. No special “smolt equivalent” estimation is performed because the emigrants are all considered smolts.

A more complex example, where the "smolt equivalent" concept becomes useful, is sampling fish within a population but generating a smolt numbers estimate downstream of the sampling site. IDFG estimates the number of Chinook salmon smolts each year from the South Fork Salmon River (SFSR) in central Idaho. If all these fish overwintered in the SFSR and smolted during a brief springtime period, then IDFG could estimate the number of smolts on their way downstream in the spring and provide a juvenile outmigrant estimate for the population as they leave the SFSR, as is done for the Umatilla River steelhead. But the majority of Chinook salmon leave the SFSR during the summer and fall as parr, rather than as smolts the following spring. Because of this protracted migration period, if IDFG is to produce a complete estimate of the number of juvenile outmigrants then they must capture parr on their way downstream in the summer and fall, as well as smolts during the following spring. This reality of field sampling dictated by the life history of the fish introduces a new need: because mortality is a continuous process, IDFG cannot simply add the number of summer parr + fall parr + spring smolts. Rather, an end point must be defined, and a survival rate to that end point must be applied to each of these groups if their numbers are to be added. If we define the end point as the smolt stage, then:

$$\begin{aligned} & (\text{Summer parr}) * (\text{Summer parr survival rate to smolt stage}) \\ + & (\text{Fall parr}) * (\text{Fall parr survival rate to smolt stage}) \\ + & (\text{Spring smolts}) * 1.0 \quad [\text{Because they are already smolts, survival to smolt stage is } \\ & \text{100\%.}] \\ = & \text{Final smolt estimate} \end{aligned}$$

The "Final smolt estimate" in the equation above is the "Smolt equivalents", and the data may look like this:

$$\begin{aligned}
 &100,000 * 0.2 \\
 &+ 200,000 * 0.34 \\
 &+ 10,000 * 1.0 \\
 &= 98,000 \text{ smolt equivalents}
 \end{aligned}$$

The word "equivalents" is used because the 100,000 summer parr, due to their 20% survival rate to the smolt stage, are equivalent to only 20,000 smolts – a 5:1 ratio. Similarly, it takes roughly 3 fall parr to yield one smolt. Smolts, on the other hand, are already smolts and thus are not discounted.

The example above is a simplification. In reality, IDFG sets the end point for this population as "smolts at Lower Granite Dam" because that is where tagged fish are detected. ([ODFW has a similar method for estimating Grande Ronde River population estimates to Lower Granite.](#)) They therefore need to estimate the number of fish in each group (summer parr, fall parr, and spring smolts, based on trap data) and the survival rate of each group to Lower Granite (based on PIT tag data). Here are IDFG's actual data for outmigration year 2018. The value in the lower right (48,198) is the estimated smolt equivalents for that outmigration year.

Capture season	Emigrant abundance at trap	Survival to LGR	Smolt abundance at LGR
Summer 2017	55,935	0.23	12,865
Fall 2017	117,507	0.28	32,902
Spring 2018	5,403	0.45	2,431
TOTAL	178,845		48,198

While calculations can be more complicated for other sampling situations, or species such as steelhead with more variable life histories, the basic "smolt equivalent" concept is the same: accounting for survival rates to the smolt stage at a specific location.

In this example, 48,198 is the HLI for this year. The "metrics" used to calculate that HLI value are the individual abundance measures and the survival rates. To share these metrics, if desired, use the JuvenileOutmigrantsDetail table.

One final note: Many trapping operations capture "transitional" or "presmolt" fish that are not quite fully smolted, but the researchers include them in the number of smolts. In such cases you would include that information in the methods, but there is no need to try to slice and dice life stages more finely than how you already analyze your data.