Pink Summary table

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| --- | --- | --- | --- | --- | --- | --- |
| years | stanza | CV | CV bias | escapement bias | recommendations | comment |
| 1957-85 | PSC MR  System specific | 0.2 | MR assumptions, peak live+dead correction factor | biased high via tagloss assumption, but corrected later | delete or increase escapement & CV for '57. Break '57-61 into own stanza with higher CV (0.35?) | p. A42 of Andrew and web has tables of CVs by region-year |
| 1987-91 | DFO MR  System specific | 0.2 | As above |  |  | Seems ok |
| 1993-2001 | DFO MR mainstem | 0.2 | As above, but more . Stopped carcass recovery in ’97. |  |  | Seems ok |
| 2003-07 | PSC test fishery | 0.5 | constant (no inter-annual variation) and spatial (johnstone straight = 3\*q\_JDF) catchability assumptions |  | Change to .4 (p.10) | accounted for revised run sizes (p.77) |
| 2009-11 | Mission post-season | 0.35 | species composition | negative bias via saturation (p.79) and fish swimming too close to transducer | increase estimates to account for swimming close to transducer? |  |
| 2013-21 | Mission in-season | 0.35 | species composition | As above | As above |  |

**Pink escapement notes**

**(from Grant et al. 2014 unless otherwise specified)**

**organized by sampling stanza**

1. **1957-85 IPSFC mark recap cv=0.2**

CV summary: annual CVs are confounded by a variety of CVs assigned to certain methods within watersheds and sub-watersheds. If you aggregate these, they range from .05-.15.

Notes:

-Escapement was generated for virtually all spawning areas including those < 1,000 pink typically spawn.

-3 methods used depending on number of spawners in system: mark recap, peak live + dead\*(assumed expansion factor), weirs where available.

-Mark-recap in 5 big systems, low precision estimates (peak live + dead \*correction\_factor) in smaller systems, but about 92% of the stock was estimated with M-R.

-For tagging estimates, the same approach was used to *estimate variances as for a normal Petersen estimate* (Ricker 1975) (Andrew & Webb 1987 [report CVs and mean CVs](https://github.com/Pacific-salmon-assess/fraser-pinks/blob/main/misc/Andrew-Webb-1987-TableC4.csv) for systems in table C4 that range from 5 to 14.7%).

-For escapement estimates based on complete counts of live or dead fish (fence count), a CV of 5% was assumed.

-Andrew and Webb (1987a) found that a) there was only estimates where precession could be estimated and b) there was some double counting of estimates where things were independent or part of a group. *But they fixed these when they recalculated the raw data in 1987* (see Andrew and Webb 1987a p.A24)*?*

- Andrew and Webb (1987a) Didn’t use 1957 in analyses of precision and accuracy because they note methods were changed a lot in subsequent years.

-For escapement estimates based on complete counts of live or dead fish (fence count), a CV of 5% was assumed. For estimates based on the peak live count + cumulative dead visual survey method, the CV was related to the number of surveys conducted. If there was only a single survey, the CV was assumed to be 39%. If there were multiple surveys, the inverse of the square root of the number of surveys was subtracted from 39% (or 0.39, p.63).

-For visual surveys large streams with relatively large Pink Salmon populations were surveyed multiple (4 to 7) times, while smaller streams with smaller populations were surveyed opportunistically, sometimes only once-per-season (Andrew & Webb 1987a).

-Peak live count was added to cumulative spawners then multiplied by 2.6. 2.6 was based on a single study in 1957! A similar study found an expansion factor of 5.2.

* 1. **Tag loss biases escapement estimates**

-In 1957-61 tagging and recovery efforts were considered insufficient to meet the assumptions of the Petersen mark-recapture method (i.e. minimal spatial and temporal application bias, handling stress mortality, tags removal in gillnets, and *no assessments of tag loss*). (note: ignoring tag loss means pops would be biased high).

-Beginning in 1963, tagging and recovery efforts were increased and, in the lower Fraser River mainstem program, the number of tags applied was adjusted in the Peterson mark-recapture escapement calculation by subtracting tags lost: this included 1) an assumed 5% tag loss; 2) tagged adults caught by in-river fisheries upstream of Duncan Bar; 3) an estimate of tags lost to migration of tagged adults into tributaries (Hourston et al. 1965).

-Andrew and Webb considered the *5% tag loss factor of Mission-applied tags to be the single largest source of consistent bias in the escapement estimate*. A study conducted by Cass and Whitehouse (1993) used data from 1989 and 1991, and identified a wide array of tag loss rates in different streams, ranging from *1% to 26%* (cited in Schubert et al. 1997) A subsequent study by Cass et al. (1995) used data from 1993 (double tagging fish with Petersen disk tags and cinch up tags), and identified a tag loss rate of *4.2%* (which would bias the population estimate *slightly* high).

1. **1987-91 DFO mark recap cv=0.2**

CV summary: treat similar to ’57-’85. Unsure where raw data similar to Andrew & Webb table C4 would be.

Notes:

-"general consistency" with 57-85 methods. Review and assumption testing in 1987 by Andrew & Webb, and assume these were corrected via reconstructed estimates from raw data (see Andrew and Webb 1987a p.A19).

1. **1993-01 DFO mark recap in mainstem cv=0.2**

CV summary: Similar to previous studies but more uncertain? Need to locate these files and dig in more. Error would be based on some mark recapture assumptions.

Notes:

-Total (estimated downstream) and net escapement (total minus upstream catch) estimates.

-Tagging in mission via beach seine. Carcass recovery in lower mainstem (Chilliwack-Vedder River confluence to Ruby Creek in the Fraser Canyon). Live recapture 22km upstream from tagging site.

-Stopped doing a mainstem carcass survey in 97 because it wasn’t representative; problems with recovery and observer efficiency.

-similar assumptions with tagloss affect CV on these estimates.

1. **2003-07 PSC purse seine test fishery cv=0.5**

CV summary: Estimate is based on assumptions on historical catchability.

Notes:

-The subtraction of all catches from the total run size resulted in an estimate of net escapement to the Fraser River that is analogous to the net escapement estimates derived from other methods in prior and subsequent years.

-Because the method involved no direct assessment of the abundance of Pink Salmon in the Fraser River, estimates in these years (2003-2007) are qualitatively different from previous years’ (1957 to 2001) and subsequent years’ (2009 to present) escapement estimates that were directly assessed by either mark-recapture or hydroacoustic programs conducted in the Fraser River.

-Yearly estimates of catchability for 1987 to 2001 and 2009 to 2013 were produced, where N was known from other escapement methods and CPUE was recorded for the test fishery. The total returns (N) in each year were based on the sum of catch and escapement and thus were independent of the test fishery CPUE. The median of these yearly catch ability estimates was then used to calculate total return and escapements for 2003, 2005 and 2007.

* 1. The catchability assumption affects the accuracy and precision of estimates

-The average daily CPUE divided by an estimate of the *average historical catchability* for each test fishery was used to estimate the daily abundances for the duration of the Pink Salmon migration.

-*Interannual variation in catchability is the largest source of uncertainty* in the Fraser Pink run size estimate for these years.

-constant (no inter-annual variation) and spatial Johnstone straight catches 3x the fish of Juan de Fuca.

1. **2009-11 mission post season cv=0.35**

CV summary: uncertainty arises from assumptions with marine catch, counts at sonar, and species composition at sonar. Need to find quantitative methods/data of how this uncertainty is accounted for to get CV.

Notes:

-PSC runs hydroacoustic estimates to get total escapement, then in river catch is subtracted to get net escapement.

-There were acoustic estimates back to ’77 but advancements in tech didn’t make them reliable till ‘09. -Pre 2009 estimates were underestimates because they didn’t detect nearshore migrating pinks. 2009 did 2 split beam didson and a mobile split beam sounder.

-Sub sampling procedure yields a CV of 5.7% (p.12) but this is only 1 potential source of error.

-“the variation associated with daily Pink Salmon estimates is only slightly larger than the variation in the daily total Salmon estimates (i.e. CV: 7%; Xie and Martens 2014)” (p.14) – don’t understand

* 1. Sonar method biases arise from species composition assumptions and issues with detection

-Some difficulties in separating out which salmon are pinks, used proportion caught in Whonnock test fishery, expert judgement, or proportion in PSC test fisheries. Assumed species composition was compared to another PSC stratified fish wheel method (p.14).

-negative bias via saturation and fish swimming too close to transducer (p.79)

-sources of uncertainty for hydroacoustic escapement estimates:

freshwater: sonar counts, species composition

saltwater: catchability assumption, run timing

-general agreement that the CV is ~ 40% (p. 77)

1. **2013-2021 mission in-season cv=0.35 (notes from PSC report)**

CV summary: as above

Notes:

**-**2015 was first year of in-season pink assessments

-79% of pinks are picked up on left bank split beam. Right bank split beam gets 11% and mobile gets 10%.

-same species composition and detection issues as previous stanza (sec 1.4.3 says they haven’t updated species composition studies because outside scope of project).

**Other notes**

1. Partitioning survival

Grant et al. (2014) provide table 1 which has estimates of freshwater and marine survival.

1. Juvenile enumeration

Since a constant volume of fish is always sampled at mission (a given boat RPM for 15 min interval) there could be a way to get juvenile abundance by comparing CPUE, marine survival, and (an assumed?) catchability.

1. Fraser river pink salmon fry abundance status quo

The daily estimate of fry concentration (fry-per-unit-volume, weighted for trap efficiency, lateral flow distribution, and vertical, and diurnal fry distribution) was multiplied by the daily discharge estimate for the Fraser River at Mission to calculate a daily estimate of total number of fry past Mission.