Analysis of reported release and collection results from Cramer (1996) in comparison to CRiSP v1.5.3.

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Introduction

Cramer reports detections at McNary Dam for each daily release of PIT-tagged yearling chinook below Lower Granite Dam, with releases beginning on April 9 and concluding on June 1. Survival estimates are based on lumping detections into particular periods; each period is characterized by a single “collection efficiency” (discussed below). Based on the number of detections and the period-wise collection efficiency, Cramer estimates the actual number of fish passing McNary Dam in each period, sums over all periods, and divides into the release number to obtain a total survival for that release.

Collection Efficiency and FGE

Collection efficiency is determined by selecting a subset of detected fish: those fish that are detected at locations below McNary Dam. In 1996, this is the John Day facility (JDD) and the Bonneville flat-plate detector (BNV). These detections are pooled, and then the number of those fish that were detected at McNary Dam is determined; the ratio of the latter to the former represents the *collection efficiency.* The assumption is that the downstream detected fish must have passed McNary Dam en route to John Day or Bonneville; whatever fraction of that pool is detected at McNary should represent the “detectability” of fish at that time.

Cramer breaks the season into several arbitrary periods (listed below in Table I). Each is characterized by a particular spill pattern and collection efficiency.

Table 1: Collection Efficiency and Spill fraction for Cramer’s periods.

Period	Spill Fraction Range (%)	Collection Efficiency (%)
April 21-27	44.2 - 51.9	12.8
April 28-30	55.3 - 61.1	18.4
May 1-6	43.7 - 51.3	26.2
May 7-11	39.9 - 43.1	31.5
May 12-14	33.6 - 41.2	34.3
May 15-16	44.1 - 47.2	24.2

Table 1: Collection Efficiency and Spill fraction for Cramer's periods.

Period	Spill Fraction Range (%)	Collection Efficiency (%)
May 17-20	57.3 - 64.2	14.1
May 21-23	52.4 - 54.5	20.2
May 24-30	64.5 - 72.8	14.4
May 31-June 6	62.9-68.1	5.0
Average	52.6	21.0

Note that these numbers allow us to estimate FGE at McNary for these fish, because:

$$CollectionEfficiency = FGE \cdot (1 - (Spill \cdot SpillEfficiency))$$

and thus:

$$FGE = \frac{CollectionEfficiency}{1 - (Spill \cdot SpillEfficiency)}$$

CRiSP's calibrated FGE value for McNary Dam is 71.8% (Anderson et al. 1996). If we regress Cramer's observed collection efficiencies against the mean spill fraction for that period, assuming that spill efficiency is near 1, the intercept of that regression (where spill = 0) is an estimate of FGE. The slope should be constrained to produce zero collection efficiency at 100% spill. Results of that regression, along with the derived CRiSP calibrated curve, are shown in Figure 1 below. Note that the fit of the regression is quite good, and the two slopes are nearly identical (CRiSP slope and intercept: -0.715 and 71.8%; Cramer slope and intercept: -0.733 and 58.0%; $r^2 = 0.710$, $p < 0.005$), however, the regression on Cramer's data does not produce 0% collection efficiency at 100% spill, but instead at about 80%. If the regression is forced to pass through that point, the intercept describing FGE is only 43.8%, which seems unrealistically low. It may be that a non-linear regression would be more appropriate, or that spill efficiency is not 1.

The presence of slide gates enables a new approach to FGE calibration; namely, directly measuring it based on multiple detections downstream. I suggest we pursue this technique to obtain FGE estimates at PIT tag detection sites with available downstream detections (LGR, LGS, LMN, MCN, and perhaps JDD if collections are adequate).

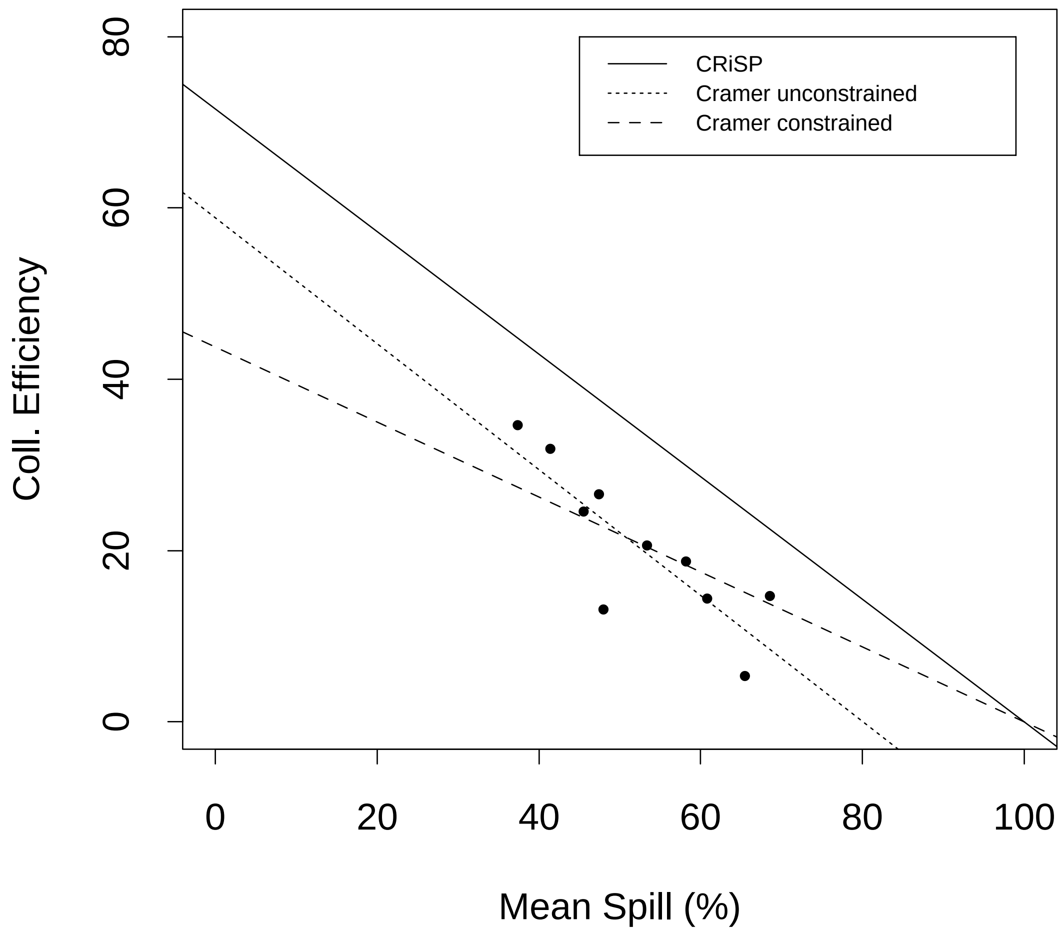

Figure 1. Estimated collection efficiency as a function of spill fraction from Cramer (1996) and for calibration of CRiSP. Unconstrained fit is simple regression, constrained is regression forced through 0% collection at 100% spill.

Comparison of Survival Estimates

Cramer produces an estimated survival to McNary Dam for each day's release. The change in survival from day to day can be considerable. CRiSP-modeled survivals, however, change in a much smoother fashion (both tracks are shown below in Figure 2). A third set of survival estimates based on Jolly-Seber survival modeling is in excellent agreement with CRiSP estimates, but not with Cramer's (S.G. Smith, NMFS, pers. comm.; see Figure 2) Why do the estimates differ?

First, Cramer's estimates are based on potentially small sample sizes. Releases at Lower Granite are sometimes fewer than a thousand fish, and generally not much over 2000. Given the high spill fractions at McNary over this period, the expected number of detections is typically only a hundred or so, and often less. This means that vicariance and natural stochasticity play a role: small sample sizes mean that small effects are magnified.

Second, Cramer lumps all PIT-tagged fish into a single class. They are assumed to be independent and identically distributed in their behavior. This is certainly not accurate. If, for example, a particular week’s releases are dominated by individuals from a particular hatchery, they may well have shared properties such as exposure to BKD, and will certainly have shared properties stemming from the migration from hatchery to Lower Granite Dam. Different hatchery stocks can be expected to behave differently. It would be worth making the effort to distinguish these differences in the identity of the tagged fish to see if there are consistent differences in survival from Lower Granite to McNary Dam.

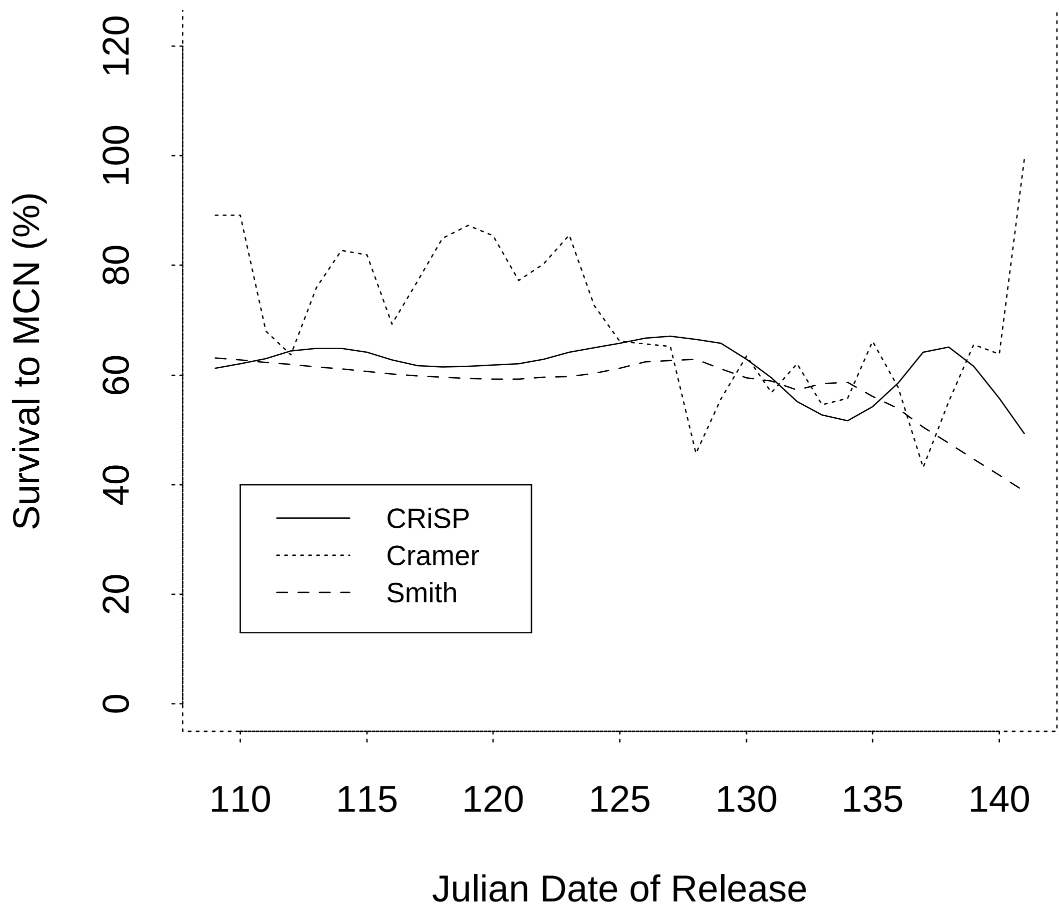

Figure 2. Estimated survival of daily releases from Lower Granite Dam to McNary Dam by Cramer (1996), CRiSP, and Jolly-Seber analysis (S.G. Smith, pers. comm.).

Both Cramer and CRiSP suggest a decline in survival from early in the season to late in the season, but the amount of variation expressed in Cramer’s estimates is considerably more than CRiSP expresses. I suggest this is because Cramer captures day-to-day variation that is not within the scope of a generalized model like CRiSP. The fact that the trend is similar and the range of values overlaps much of the time is encouraging.