

Memo on correction factor for feather spots

By Julie Yee

December 1, 2009

Purpose

During the September 2009 SRC meeting, the SRC agreed to recommend that the number of small fresh carcasses and feather spots be adjusted by a correction factor based on the 48-Hour Search Interval (KB) Study (M32). The KB Study provides new information on how to refine the rate of disappearing evidence for small bird fatalities. Furthermore, this study revealed relatively large numbers of Burrowing Owls reduced to feather spots within 2 days after death, and substantial differences in disappearance rates for whole carcasses and feather spots. The SRC has recommended that feather spots be handled differently from carcasses, but have not yet recommended how to derive the appropriate rates for feather spots. To facilitate a discussion of this issue, several options for deriving rates were discussed in a meeting between the Monitoring Team (MT) and SRC subcommittee on November 4th and 6th, 2009 (see M41). This memo presents simple quantitative examples of these approaches for purposes of demonstrating their respective strengths and weaknesses.

Options

- 1) Adjust fatalities respectively by their condition when found. In other words, adjust carcasses using carcass removal rates and adjust feather spots using feather spots rates. No special consideration is given to transitions.
- 2) Adjust carcasses using carcass removal rates, and do not adjust feather spots.
- 3) Same as 1), except refine the feather spots adjustment to account for the proportion of fatalities that transitioned from a carcass.
- 4) Combine fatalities to derive one set of rates that are applied the same to carcasses and feather spots.

Example Data

Table 1 contains hypothetical data on the removal and condition (Carcass, Feathers, or Gone) of fatalities 30 days after carcass depositing. Data are shown separately according to fatality condition within 2 days of being deposited (Carcass or Feathers).

Table 1. Hypothetical data from a carcass removal experiment.

Condition within 2-days	Condition after 30 days			Total
	Carcass	Feather	Gone	
Carcass	11	3	12	26
Feather spot	0	7	3	10
Total	11	10	15	36

Note, the cells in yellow represent data that would be gathered as raw counts 30-days after the carcass deposit. Table 2 shows evidence remaining rates, R_i , derived from data in Table 1.

Table 2. Evidence remaining rate, R_i , at 30 days, according to condition within 2 days.

Condition within 2-days	Formula for R_i	R_i
Carcass	14 / 26	0.5385
Feather spot	7 / 10	0.7000
Total	21 / 36	0.5833

The remainder of this memo contains simple worksheet examples designed to illustrate the four different options for using this data to adjust raw counts. In the interest of keeping the calculations simple, I omit two major components of the standard adjustment because they require additional calculations that have little bearing on the comparison between the four options. First, I omit the concept of carcasses deposited partway into a 30-day interval. The standard analysis requires separate calculations of R_i over a range of $i=1, 2, \dots, 30$ days in order to account for carcasses that may have fallen on any one of the 1 to 30 days prior to search. In the standard analysis, fatalities are assumed equally likely to occur on any of the 30 days, and the resulting adjustment is based on R_c , where R_c is the average of R_i . In order to avoid diagramming 30 versions of Tables 1 and 2, this memo only considers the simplistic situation pretending carcasses are only deposited on day 1 so that there is only one R_i rather than 30. Second, this memo assumes searcher efficiency is perfect, where any remaining evidence is always found, i.e. $p=100\%$. Therefore, for purpose of these examples, the R_c and R_i are equal and the usual adjustment factor $1/(p \times R_c)$ is simplified to $1/R_i$.

Next, I acknowledge that these adjustment factors will not always be perfectly accurate, due to variations in sample across sites and time. However, at a minimum, these factors should perfectly adjust the raw counts for the same data from which those adjustments were derived. Using Option 4 as the first example, the following two tables show the raw counts and the adjusted count when pooling all fatalities across carcass types.

Table 3. Fatalities counted at 30 days, according to condition when found.

Condition at 30 days	Raw count
Carcass	11
Feather spot	10
Total	21

Table 4. Option 4: Total fatalities (pooled across evidence condition) adjusted by a single R_c based on total rate from Table 2.

Condition at 30 days	Formula for adjusted count	Adjusted count
Total	21 / 0.5833	36.0

When pooling all evidence conditions, the adjusted count is exactly equal to the 36 fatalities that were actually monitored in the carcass removal study. Conversely, the

next two tables show a bias when raw counts are adjusted separately according to evidence condition (Option 1) or when feathers are not adjusted at all (Option 2).

Table 5. Option 1: Fatalities adjusted separately by evidence condition.

Condition at 30 days	Formula for adjusted count	Adjusted count
Carcass	11 / 0.5385	20.4
Feather spot	10 / 0.7000	14.3
Sum		34.7

Table 6. Option 2: Carcasses adjusted, feather spots not adjusted.

Count	
Adjusted Carcass count	20.4
Unadjusted Feather spots	10.0
Sum	30.4

Option 1 is biased because the two rates, 0.5385 and 0.7000, represent fatalities classified respectively as carcass or feather pile *within 2 days* of death, whereas raw counts are classified at discovery approximately *30 days* after death. Three of the carcasses transitioned to feather spots later than 2 days of death, and it would have been more appropriate to adjust these 3 raw fatalities using the carcass rate rather than the feather rate. For example, the next table illustrates how the Option 1 calculation becomes unbiased after reallocating these late-transitioned fatalities from the raw feather count to the raw carcass count:

Table 7. "Crude" Option 3: Option 1 after reallocating 3 of the 10 feather spots to the Carcass classification.

Condition	Formula for adjusted count	Adjusted count
Carcass	14 / 0.5385	26.0
Feather spot	7 / 0.7000	10.0
Sum		36.0

This last example demonstrates one of two approaches discussed in the November 4-6, 2009, subcommittee meeting for implementing Option 3. In this version of the Option 3 approach, the KB data would be used to estimate the proportion of discovered feather spots that "originated" as carcasses (i.e. fatalities that transitioned to feather spots later than 2 days after death). In this example, the estimated proportion was 30% (3 out of every 10) for a 30-day interval, and similar proportions would need to be estimated for all other survey intervals. These corresponding proportions of feather spots would then be reallocated to the raw carcass count prior to applying Option 1. In the subcommittee meeting, this approach was referred to as the "crude" method for Option 3. The other approach for Option 3 which was discussed involves formal concepts of transition matrix models and is beyond the scope of this memo.

In a situation where a monitoring program is similar to the KB study with regard to their relative proportions of carcasses and feather spots as well as their disappearance rates,

then we can reasonably expect Options 3 and 4 to perform well whereas Options 1 and 2 are prone to bias. However, in a situation where the proportions of feather spots vary relative to proportions of carcasses, then Options 3 and 4 will also be prone to bias. Moreover, the bias associated with Option 1 is mitigated if very few carcasses transition to feather spots (later than 2 days after death).

The attached worksheet contains calculations for three scenarios of a hypothetical monitoring program in which the proportion of carcasses and feather spots (condition within 2-days) are

- A) consistent with carcass removal study,
- B) widely different from carcass removal study, or
- C) widely different from carcass removal study and transitions virtually do not occur.

In scenario A, Options 3 and 4 perform best due to their ability to accommodate carcasses transitioning to feather spots; however, this advantage relies on consistency in the proportion of feather spots. Conversely, in scenario C, Option 1 performs best due to its ability to handle different proportions of feather spots, however assumes that transitions virtually do not occur. The most likely scenario may be B in which all options are prone to bias. The attached worksheet is provided in Excel format so that we can see what happens to the adjusted counts when different hypothetical monitoring data are entered. Although none of the options are ever correct in scenario B, certain options may perform better than others in general. For example, Option 1 is better than Option 2, and Option 3 seems to always be at least as good as 4.

P-141 Worksheet accompanying Memo on correction factor for feather spots

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Insert any numbers into tan cells and worksheet will update.

Box 1. Hypothetical carcass removal study such as KB study. The rates derived from this data (green values) would be applied to raw counts from the monitoring study after a 30-day monitoring interval (yellow values).

Table 1. Hypothetical carcass removal experiment

Condition within 2-days	Carcass	Feather	Gone	Total
Carcass	11	3	12	26
Feather	0	7	3	10
Total	11	10	15	36

Table 2. Evidence remaining rate, R_i , at 30 days

Condition within 2-days	Formula for R_i	R_i
Carcass	14 / 26	0.5385
Feather	7 / 10	0.7000
Total	21 / 36	0.5833

Green values derived via carcass removal study and applied to raw counts.

Yellow values represent raw counts.

Accurate adjustments are highlighted pink.

Proportion of feathers spots to reallocate: 0.3

Boxes 2. Three scenarios of hypothetical monitoring in which the proportion of carcasses and feather spots (condition within 2-days) are consistent with carcass removal study (Box 2A), different from carcass removal study (Box 2B), or different from carcass removal study and transitions virtually do not occur (Box 2C).

Box 2A. Proportion of carcasses and feather spots are consistent with carcass removal study.

Condition within 2-days	Carcass	Feather	Gone	Total
Carcass	110	30	120	260
Feather	0	70	30	100
Total	110	100	150	360

Option 1. Fatalities adjusted separately

Condition	Formula adj. count	Adj. count
Carcass	110 / 0.5385	204
Feather	100 / 0.7000	143
Sum		347

Option 2. Summing adjusted carcasses with raw

Count	Adj. count
Adjusted Carcass count	204
Unadjusted Feather spots	100
Sum	304

Option 3. Modified Option 1 (reallocate feather spots)
Number of feather spots to reallocate: 30

Condition	Formula adj. count	Adj. count
Carcass	140 / 0.5385	260
Feather	70 / 0.7000	100
Sum		360

Option 4. Total raw fatalities adjusted by single R_c

Condition	Formula adj. count	Adj. count
Total	210 / 0.5833	360

Box 2B. Proportion of feather spots vary substantially from carcass removal study.

Condition within 2-days	Carcass	Feather	Gone	Total
Carcass	110	30	120	260
Feather	0	210	90	300
Total	110	240	210	560

Option 1.

Condition	Formula	Adj. count
Carcass	110 / 0.5385	204
Feather	240 / 0.7000	343
Sum		547

Option 2.

Count	Adj. count
Adjusted Carcass count	204
Unadjusted Feather spots	240
Sum	444

Option 3.
Number of feather spots to reallocate: 72

Condition	Formula	Adj. count
Carcass	182 / 0.5385	338
Feather	168 / 0.7000	240
Sum		578

Option 4.

Condition	Formula	Adj. count
Total	350 / 0.5833	600

Box 2C. Proportion of feather spots vary substantially but transitions virtually do not occur.

Condition within 2-days	Carcass	Feather	Gone	Total
Carcass	140	0	120	260
Feather	0	210	90	300
Total	140	210	210	560

Option 1.

Condition	Formula	Adj. count
Carcass	140 / 0.5385	260
Feather	210 / 0.7000	300
Sum		560

Option 2.

Count	Adj. count
Adjusted Carcass count	260
Unadjusted Feather spots	210
Sum	470

Option 3.
Number of feather spots to reallocate: 63

Condition	Formula	Adj. count
Carcass	203 / 0.5385	377
Feather	147 / 0.7000	210
Sum		587

Option 4.

Condition	Formula	Adj. count
Total	350 / 0.5833	600