

**Review of American Kestrel-Burrowing owl (KB) Scavenger Removal Adjustments
Reported in Alameda County Avian Monitoring Team's M21 for the Altamont Pass Wind
Resource Area**

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Summary: Because the removal curves derived from the KB study deviated so greatly from removal curves from other studies, as well as from an earlier report of the KB study, I obtained the spreadsheet and scans of original data sheets from the monitoring team and I attempted to reproduce the monitoring team's results. I could not reproduce the monitoring team's results in M21, nor do I understand entirely how their results were obtained. However, it appears that the monitoring team omitted the earliest two days of each removal trial from its estimation of removal curves; that is, the two days preceding carcass discovery and since the last fatality search were not factored into the estimation of scavenger removal rates. This omission was critical because the first two days after carcass deposition are when vertebrate scavengers remove the greatest daily proportion of carcasses without leaving a trace of evidence. Other problems appeared to have been the monitoring team's determinations of when carcass remains would no longer be "detectable" as a fatality, use of data from outside the KB study, and numerous database errors. I recommend not using the removal curves in M21 to adjust fatality rates, and I provided alternatives.

INTRODUCTION

In 2006 the Alameda County Scientific Review Committee (SRC) recommended a special study to test whether 2-day fatality search intervals rather than the targeted 30-day intervals would detect greater numbers of small raptor and other small bird carcasses at wind turbines in the Altamont Pass Wind Resource Area (APWRA). A secondary objective was to monitor the condition of the found fatalities to derive more conventional scavenger removal rates, but in this case without placing carcasses and potentially swamping the local vertebrate scavengers (see Smallwood 2007). The study was initiated in September 2007 and field work was completed in May 2008. The monitoring team produced an initial report of the study in June 2009, but debate over whether and how to treat feather piles and partial carcasses differently from intact carcasses resulted in the formation of an SRC subcommittee (Julie Yee and myself), which was directed to work with the monitoring team in deriving new scavenger removal rates from the data.

The subcommittee and monitoring team arrived at general agreement over assumptions and methods by late November 2009. On 3 December 2009 the monitoring team assured the subcommittee that a new review of the data since the last subcommittee meeting had not substantially changed the scavenger removal rates. However, the December 2009 release of the APWRA fatality monitoring report, M21, reported much slower removal rates than I anticipated, and much slower than reported across the US. The monitoring team did not explain the discrepancy between the rates shared with the subcommittee and those reported in M21, other than the data had been reviewed again. Therefore, I reiterated my standing request for the

original data sheets so that I could attempt to reproduce the monitoring team's removal rate results and to better understand the data.

METHODS

On 3 December 2009 I was promised the KB data. On 23 March 2010 I received scans of 61 fatality data sheets from the KB study. Some of these scans were partly illegible due to poor scans, and the sheets were incomplete. I have been told that I can copy the remaining data sheets, but I was also told that the sheets sent to me include all the small bird carcass data that the monitoring team used to estimate their removal curves in M21. (Some of the sheets I was given were also of large birds, but I had no difficulty isolating these sheets.) The monitoring team also supplied me with a spreadsheet of the data (with 3 worksheets including data), but these data were not arranged in a manner that I found suitable for analysis, some variables were undefined, and it was unclear which records were used by the monitoring team to generate removal curves.

I modified one of the worksheets to establish a format that was more accommodating to analysis, i.e., a single record per spreadsheet row. I entered data on carcass condition from most but not all data sheets – just enough to understand when the fatality remains were unlikely to be detected during a standard fatality search. Also, I used the carcass diagnostics to identify fatalities that were caused well more than 2 days before the discovery date, such as if the flesh already dried or the eyes were sunken. I used the diagnostics to also identify which carcasses were already visited by vertebrate scavengers and which were already inhabited by invertebrate scavengers such as ants, maggots, or yellow-jackets.

I compared the descriptions of remains on data sheets to the operating fatality definition in the APWRA: At least 2 primaries, or ≥ 10 feathers, or ≥ 5 tail feathers (SRC Meeting Notes of 12 June 2007). Another part of the definition that was written in the SRC's notes, but which should be understood as operational, is the occurrence of bone material or any other remains that would indicate a mortal injury. The monitoring team's spreadsheet indicated that monitored carcasses were sometimes recorded as "detectable" as a fatality, even after the fatality definition was no longer met. In my analysis, I reversed this characterization whenever I observed that the evidence recorded on the data sheet did not meet the fatality standard (see Appendix for examples).

The monitoring team supplied me with data sheets and spreadsheet records from the standard fatality monitoring based on an approximate 30-day search interval. I did not use these records because they were not from the KB study; they presented much greater ranges of error in estimating how recently the fatalities had occurred. It is for this reason that, as far as I am aware, nobody other than the Alameda County Avian Monitoring Team has attempted to estimate removal curves based on carcasses found during routine fatality searches. This practice is not acceptable (see Discussion section).

RESULTS

Whereas M21 reported 35 small bird fatalities were used to generate removal curves, I found that 29 were marginally suitable for use in generating removal curve. Of these, 6 were freshly killed and intact (2 were of small raptors), 12 were already scavenged and consisted of body parts or intact carcasses that were partially consumed (5 of these were of small raptors), and 11 consisted only of feathers when found (9 of these were of small raptors). The proportion of carcasses remaining by day did not differ visually between fresh intact carcasses and feather piles, but scavenged carcasses exhibited a slightly different removal curve (Figure 1).

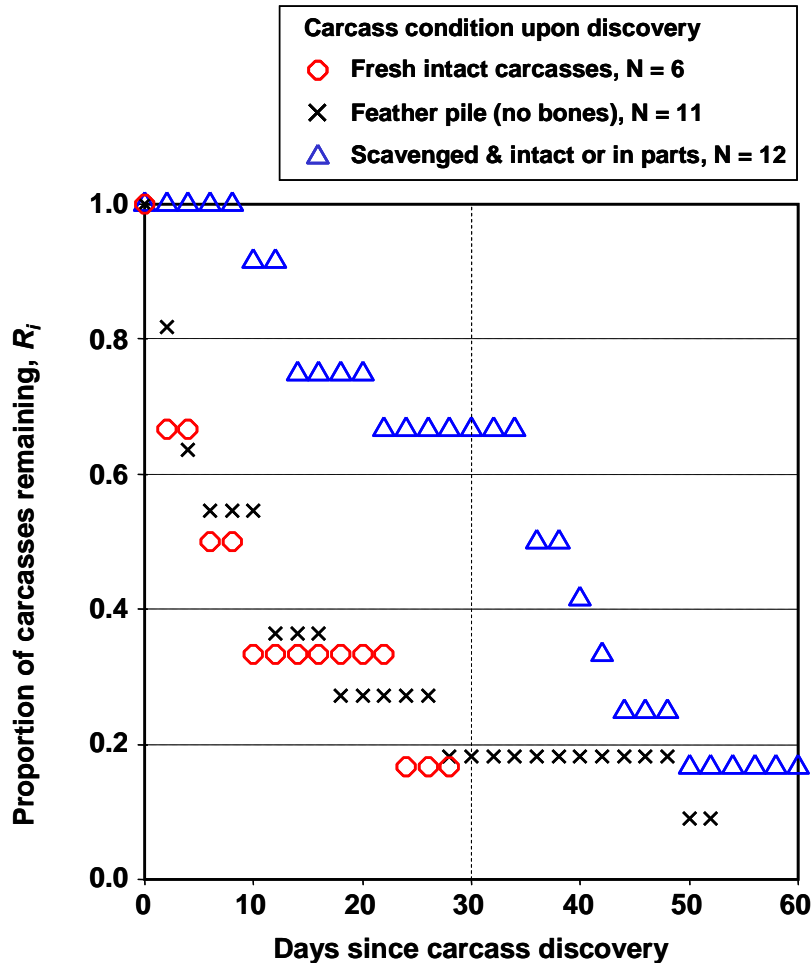


Figure 1. Small bird carcasses remaining by day during KB study, in which the discovery date was treated as the trial beginning each case, similar to carcass placement dates in conventional removal trials.

The removal curves appeared sufficiently similar to me to justify combining the data for a single curve, as Julie Yee consistently advocated. A combined curve should be comparable to removal curves generated by placed birds in more conventional removal trials, but I did notice a fundamental difference in how the monitoring team apparently generated its removal curves. While examining the data I noticed that days remaining appeared to be the number of days since the carcass discovery, but not since the last search. For the removal curves to be comparable to

conventional scavenger removal trials based on volitional carcass placement, the number of days to removal would need to be counted since the last fatality search preceding discovery. The first two days of each removal trial appeared to be omitted from the removal rate estimates, and these first two days are the most critical days for establishing the shape of the curve.

To exemplify the effect of omitting the first two days from the adjustment curves, I used removal data from the Vasco Caves study that was performed in 2007-2008 (Smallwood et al. 2010). In that study, carcasses were volitionally placed in front of camera traps, which were used in combination with site visits to monitor the fate of each carcass. The Vasco Caves trials also involved no more than 5 carcasses placed at any given time, and were spread across the study area to minimize scavenger swamping. After using the data to generate a removal curve for small birds, I then generated another removal curve after omitting carcasses that had been removed during the first two days of each trial (Figure 2). Omitting the carcasses removed during the first two days resulted in a slower removal curve, which could more than halve fatality rates estimated from search intervals of 30 days.

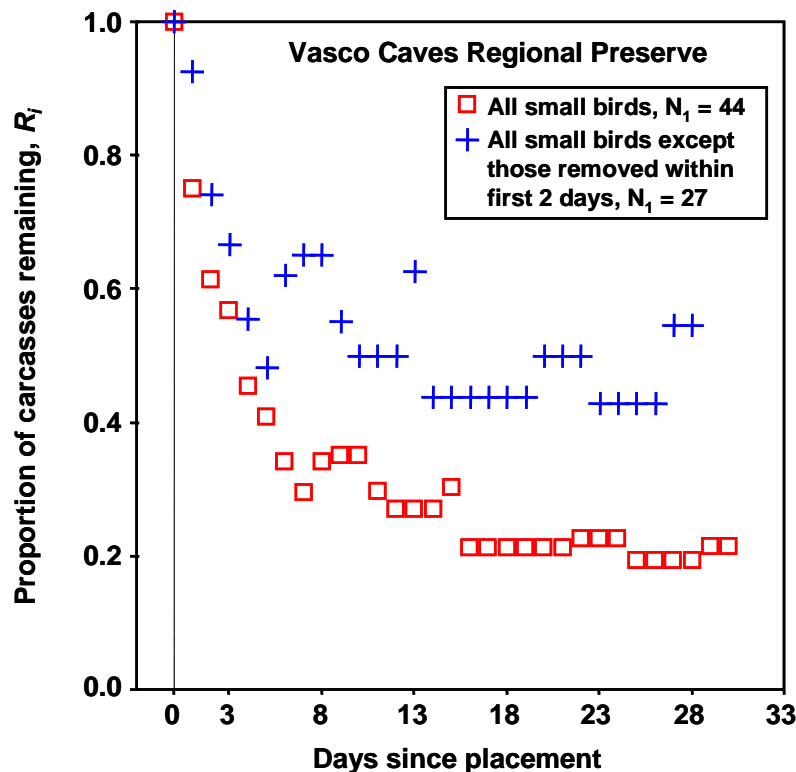


Figure 2. Comparison of Vasco Caves small bird removal rates based on all carcasses (red squares) and those remaining at least two days into the trial (blue crosses). All carcasses were volitionally placed.

Taking this lesson back to the KB data, I attempted to adjust the removal curve for the number of carcasses the monitoring team likely did not detect because they had been removed by scavengers without leaving a trace of evidence between the time the fatality occurred and the next fatality search. Accounting for an equal likelihood that a found carcass was deposited by the wind turbine on any day since the last fatality search, I used the cumulative proportion of

carcasses remaining after two days in the Vasco Caves study to project the number of carcasses that were not detected in the KB study. Making this step relatively easy was the between-study similarity in sample sizes of small bird carcasses remaining at two days since the last search. The number of carcasses not removed after 2 days was 27 in the Vasco Caves study, and the number of suitable carcasses found 2 days since the last search in the KB study was 29. In the Vasco Caves study, the cumulative proportion of placed carcasses remaining at two days was less than the placed proportion by one third, so adding this cumulative proportion back into the KB study added another 15 small bird fatalities. That is, assuming removal rates were similar over the first two days between the Vasco Caves study and the KB study, the number of small birds suitable for the KB removal trial should have been about 44. Therefore, I generated another KB removal curve, using 44 small bird fatalities as my starting point (Table 1, Figure 3).

Table 1. Least-square regression models of proportion of carcasses remaining regressed on days since placement (Vasco Caves study) or since the last fatality search (KB study), where, a and b were fitted coefficients.

Group	Model	r^2	n	P-value	a	b
All small birds	Logarithmic	0.96	29	<0.001	1.3249	-0.2909
All small birds, adjusted for 2 days preceding discovery date	Logarithmic	0.98	44 (projected)	<0.001	0.9659	-0.2162

DISCUSSION

I was unable to reproduce the monitoring team's removal rates for small birds (black circles, Figure 3). Even after accounting for carcasses removed prior to fatality discoveries in the KB study, I could not reproduce the monitoring team's exceptionally slow removal curves. It is possible that the monitoring team used some fatalities that were already old upon discovery and therefore should not have been included in removal rate estimation. There might be another explanation, but I have yet to think of it. In any case, the small bird removal curve in M21 does not appear to be supportable. It should be replaced. Until additional removal studies are performed, I suggest using averages between the removal rates from Vasco Caves and those I adjusted from the KB data (the blue and red symbols in Figure 3).

My impression is that the monitoring team's primary objective was the SRC's secondary objective. The SRC recommended the study to answer a very simple question of whether more frequent searches would indeed discover more bird fatalities. The answer was "yes," and we found more small birds and small raptors than predicted by a synthesis of the available removal curves (Smallwood 2009). However, the monitoring team apparently decided that the primary objective was estimating a new removal curve. In pursuing this objective, the monitoring team encountered a sample size problem, which it attempted to overcome by using fatality discoveries outside the KB study. Sample size is no doubt important, but so is sample quality, which is why I would not use fatality records from outside the KB study (see discussion below for more on sample quality).

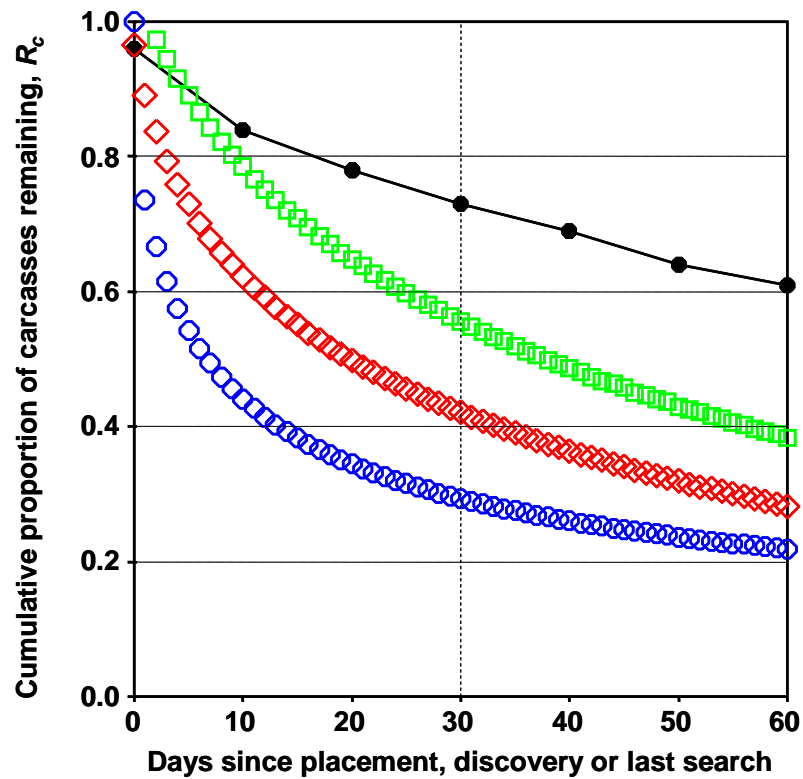
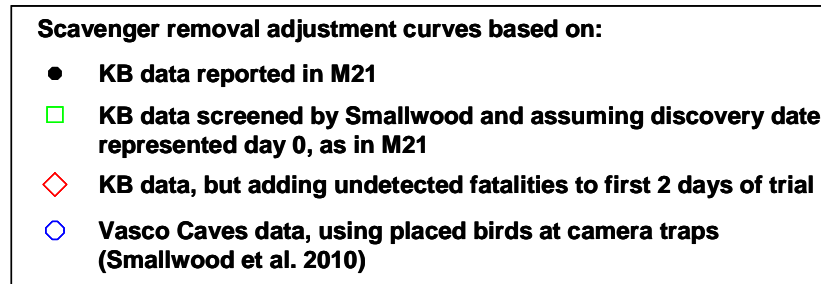


Figure 3. Comparisons of cumulative proportions of small bird carcasses remaining by day into scavenger removal trials, where a sampling of the monitoring team's removal rates are shown as black circles connected by a line, the green squares represent my estimates of removal rates using the monitoring team's approach of using the discovery date as the trial start date, the blue circles represent removal rates from Vasco Caves, and red squares represent removal rates using KB data including projected fatalities not detected over the two days between fatality searches.

Another problem with the monitoring team's primary objective was the comparability of its removal curves. The monitoring team appeared to treat the fatality discovery date as the initiation date of each "trial," whereas all other scavenger removal trials initiate with the volitional placement of a carcass in the study area. In the more conventional removal trial, the variation around the time since carcass placement is entirely controlled. In the KB study, there were at minimum two days before carcass discovery when the carcass could have been deposited in the study area. Essentially, the monitoring team treated these minimum two days as non-existent, but in a removal trial these two days are the most important days – it is when the largest daily proportions of carcasses are removed by vertebrate scavengers without leaving a trace of evidence. Therefore, to be comparable, the removal curves derived from the KB study needed to be adjusted for the first two days at minimum. In the case of the carcasses found outside the KB study, I would not even attempt to adjust those for the unknown and likely variable number of days when vertebrate scavengers would have likely removed small bird carcasses without leaving a trace of evidence.

The third major problem I observed in the KB study results was the determination of how long carcasses remained "detectable" as fatalities. In the spreadsheet the monitoring team provided, I noticed that carcass remains were regarded as "detectable" long after the remains achieved conditions that I would regard as highly unlikely to be detected by fatality searchers under normal circumstances, or that would be regarded as indicators of fatalities even if they were found. Months ago I discussed this matter with a monitoring team member, who argued that a scavenger removal trial is for monitoring the availability of remains, and should be treated independent of searcher detection error. That is, the trial is for tracking how long remains meet a fatality definition regardless of whether most searchers could actually see the remains while doing a standard fatality search. As sensible as this argument sounds at first hearing, it is unrealistic because there is no search detection adjustment that is available for the types of remains that require investigators to get on their hands and knees to find the remains they already know should be at a particular location. The available estimates of search detection error originated from various studies that relied on placement of whole birds, and not on little bits of wing bones or on body feathers that matted into the grass after several rain storms. I read on the data sheets passages such as "pretty much invisible," yet the same remains were recorded on the data worksheet as "detectable." It would be mistaken to assume that searcher detection rates are available for application to little pieces of a carcass, because no such estimates are available. Therefore, if the removal rates from the KB study are to be comparable to conventional removal trials, then it must consider searcher detection error in its determinations of when remains were no longer detectable as a fatality.

A lesser problem I noticed in the worksheets was data entry errors. I noticed quite a few errors, including missing search dates and duplicate records. I also noticed that the carcass condition diagnostics had not been entered to a spreadsheet. My impression is that the data that were entered to a spreadsheet were entered very quickly. I also understand (by email communication) that the monitoring team lost some unspecified number of carcass photos taken as part of this study. Given the amount of time and money devoted to this project, as well as the value represented by the data, I recommend that the remaining data should be entered to spreadsheets and that more effort be directed toward error-checking.

I noticed on the data sheets that monitoring team members have been interested in the effects of carcass disposition on searcher detection error. For example, some effort was made to monitor the spread of remains and the distance at which observers detected the remains. These efforts were worthwhile, though probably will not yield useful fatality rate adjustments until they are implemented in the appropriate trial. It would be useful, for example, to deploy feather piles or body parts across the ground in various spread distances to quantify detection rates, but this would need to be done in a blind searcher detection trial applied during standard searches. Searcher detection adjustment factors remain very weak, having been given insufficient attention by fatality monitors at wind farms.

REFERENCES

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APPENDIX

Record Notes (Smallwood)

2008_0307_02

This record was characterized as a KB record in the raw data spreadsheet, but all other information identified it as a CS record, including a revision on the data sheet. Which is it?

Spreadsheet included observation on 3/24/08, but the recorded date was wrong – should have been 3/27/08.

2008_0306-07

This record was characterized as a KB record in the raw data spreadsheet, but all other information identified it as a CS record, including a revision on the data sheet. Which is it? [Note: I surmised that multiple records were labeled KB in the spreadsheet only because they were added to the KB pool of fatalities to estimate removal curves.]

On the data sheet, what was meant by the following? Turbine status = N

Condition of carcass on 3/27/08 not entered to spreadsheet

Condition of carcass on 4/28/08 not entered to spreadsheet

20080325-02

The record was described as “Detectable” on 03/30/2008, but it was not detectable as a fatality in a standard fatality search. I changed the value in the spreadsheet.

2008_0403_04

This record was reported twice in ‘condition by date’ sheet. Actually, this was the case for many of the records. It would have been less confusing if this worksheet included one row per fatality record.

KB20070904-02

The spreadsheet characterization of when the carcass was undetectable did not correspond with the information on data sheet and the standard fatality definition for the APWRA. A second feather pile was found later, but it was outside the search radius. The original remains were down to only a few feathers by the second site visit.

KB20070906-01

These remains were considered as detectable as a fatality well beyond the point where most fatality searchers would normally detect the remains. After 26 days, the remains were reduced to

a single wing digit with one or two feathers attached. This was regarded as detectable for another 30 days, even though it was rained upon and notes indicated it was nearly impossible to see. I don't believe a conventional scavenger removal trial would have tracked this piece this long.

KB20070906-02

Discovery date was wrong on spreadsheet. I changed from 9/16/07 to 9/6/07. Also, the spreadsheet characterized the fatality as a carcass, but it started out as a feather pile.

The remains were determined to be detectable as a fatality throughout trial, even though they were down to a few flight feathers over latter surveys. I changed the last several determinations to "Not detectable" because the remains did not fit the fatality definition.

KB20070917-03

Spreadsheet says owl carcass was taken in 8 days, but data sheet says 4 days. Feathers were left behind. I changed spreadsheet value to 4 days before transition to feather pile.

On the 'Condition by date' spreadsheet, this carcass is described as a carcass throughout trial period, but it was a carcass for only 4 days, so I changed the last observation date on the sheet accordingly.

Similarly, the feather spot information was incorrect on this sheet. By 9/29/07, the feathers in the feather spot numbered fewer than the fatality definition would recognize. I changed the spreadsheet values to be consistent with the data sheet.

The next two rows of data representing this record made no sense, so I revised according to the data sheets. The information on the data sheets indicates the searchers were practically using magnifying glasses to locate remains. By this point the remains should have been regarded as insignificant and atypical of the sorts of remains used to determine that a fatality has been detected.

KB20071007-01

10/17/2007 recorded twice. I changed one to 10/19/2007. Also, 10/21/2007 was omitted, but I added it.

KB20071016-03

First page is too faint to read.

KB20080501-02

No data sheet was provided.

KB20070911-02

Duplicate records in Raw Data sheet on 9/14/07, 9/17/07, and 9/21/07. Missing record for 9/25/07.

KB20070917-01

Duplicate records for 9/19/07, 9/21/07, and 9/23/07.

On 10/25/2007, the fatality sheet included the note “pretty much invisible,” yet the spreadsheet reports the feathers as “detectable.” I’m finding multiple examples of this type of discrepancy.

KB20070923-03

Missing record in spreadsheet for 10/9/07.

KB20070924-01

Down to 6 body feathers on 9/26/07, so not detectable as a fatality, contrary to what was reported on spreadsheet.

KB20080303-02

7 body feathers on 11 March 2008 should have qualified record as “not detectable.”

KB20080317-02

From May 2nd onward, these remains were sufficiently difficult to see that they’d have been missed in a standard search. I changed “Detectable” to “Not detectable.”

KB20080327-01

From 4/16/08 onward, the remains were described as very difficult to see, and a comment was made that it was doubtful they would have been detected during standard searches. I changed these to “Not detectable.”

KB20080425-01

Did not meet fatality definition on 5/1 or 5/3, so changed from “Detectable.”