Memorandum

To: Cherry Keller, U.S. Fish and Wildlife Service

From: Charles Gowan and Barry Knisley, Randolph-Macon College

Re: supplement to the March, 2010 Puritan tiger beetle PVA

Date: July 15, 2010

This memo is a supplement to our March, 2010 report on a population viability analysis (PVA) for the Puritan tiger beetle. The report was discussed at a June 23, 2010 meeting involving the USFWS, MDNR, and R-MC, and several additional analyses were requested by the USFWS and MDNR. This supplement provides those additional analyses. The March, 2010 report was itself an update to an earlier report prepared by R-MC in 2005.

As agreed on June 23, all values for model parameters (correlation, dispersal, lambdas, etc.), with the exception of carrying capacity (K) for each population, were the same as those used in the March, 2010 report. All new analyses presented here involve some alteration to K for each population or new time horizons (i.e., a new number of cohorts).

New Model Runs to Facilitate Comparison Between Results from the 2005 and 2010 Reports

The same or very similar values for most model parameters were used in the 2005 and 2010 reports. The exception was K. In the 2005 report, the value for K for each subpopulation was taken as the average of the previous five years of abundance data (2000-2004) for that subpopulation. In the 2010 report, the maximum value recorded in the previous five years was used. The net effect was that Ks used in the 2010 report were around twice the values used in the 2005 report. So, comparison of results from the 2005 and 2010 reports could be used to evaluate the effects of K on extinction probability, but certain other model parameters (lambda and the standard deviation of lambda) had been changed slightly between 2005 and 2010. Moreover, the 2010 report provided results for 50 cohorts (100 years), but the 2005 report examined 5, 25, and 100 cohorts (i.e., 10, 50, and 200 years). Given these concerns, the following new models were run:

- For Strategies 1, 5, and 6 from the 2010 report, run the model using all 2010 parameter values, except use the 2005 K for each subpopulation. Repeat this for 5, 25, 50, and 100 cohorts. Present the results in the same format as Table 6 in the 2005 report. The requested analyses were run (Table 1). Comparison of data in Table 1 to those in Table 6 of the 2005 report indicate that the slightly-revised model parameters used in the 2010 report cause predicted extinction probabilities to increase by up to 10 percentage points (compare Strategy 1 from Table 1 to Strategy 1 in Table 6 of the 2005 report), but these changes are relatively minor relative to the influence of other parameters such as K (see next section).

New Model Runs to Examine the Effect of K on Extinction Probability and Strategy Selection

- Run two new strategies (herein called Strategies 9 and 10 to distinguish them from the 8 strategies included in the 2010 report) that both involve an examination of the effect of carrying capacity. Strategy 9 is to preserve all sites, but at 50% of the K used in the 2010 report. Strategy 10 is to preserve all sites, but at 85% of the K used in the 2010 report. For both strategies, keep all model parameters (K, lambdas, correlation, etc.) at the values used in the 2010 report. The requested analyses were run (Figure 1).

Results from the two new strategies indicate that a 50% loss of K at all sites (Strategy 9) dramatically increases extinction probability compared to when K is maintained at 100% (Figure 1). A smaller loss of K (Strategy 10) has only a minor effect on extinction probability (Figure 1). For example, the probability that the Calvert County metapopulation falls below 500 beetles is predicted to be about 0.4 over the next 50 cohorts if K is maintained at 100% for all sites, but this probability increases to 0.7 if K is reduced by 50% for all sites. Similarly, at Sassafras, the probability of falling below 500 beetles within the next 50 cohorts is about 0.9 if K remains at 100%, but increases to almost 1.0 if K is reduced by half.

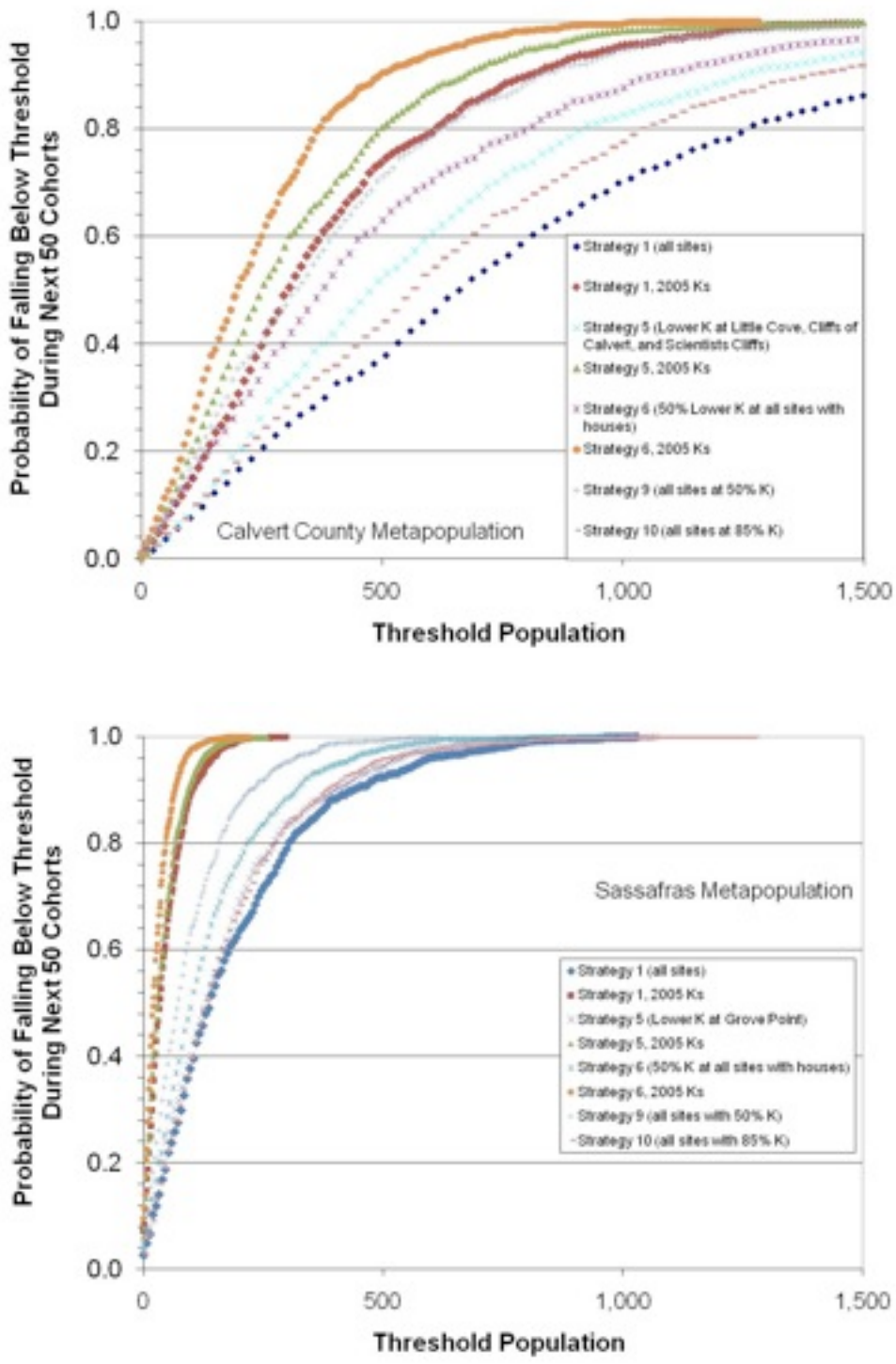

Figure 1. Interval extinction risks for Puritan tiger beetles in the Calvert County (upper panel) and Sassafras River (lower panel) metapopulation in the Chesapeake Bay region under various management strategies. Risks are shown for a period of 50 cohorts (100 years).

Table 1. Summary of extinction probability results from a metapopulation model of Puritan tiger beetles in the Chesapeake Bay region. The probability that the population will fall below 0 or 500 animals sometime during the next 100, 50, 25, and 5 cohorts is shown for the Calvert County and Sassafras River metapopulations. Probabilities were developed under each of three management strategies taken from the March 2010 report. Strategy 1: preserve all sites. Strategy 5: preserve all sites, but certain ones suffer a 50% loss in K (Little Cove Point, Cliffs of Calvert, Scientists Cliffs and Grove Point). Strategy 6: preserve all sites, but certain ones suffer a 50% loss in K (Western Shores/Calvert Beach, Calvert Cliffs Nuclear Plant, Little Cove Point, Cliffs of Calvert, Grove Point, East Lloyd Creek, West Betterton, North Still Pond).

	Probability of the metapopulation falling to 0 or to 500 animals sometime during the next:															
	100 Cohorts				50 Cohorts				25 Cohorts				5 Cohorts			
	Calvert County		Sassafras River		Calvert County		Sassafras River		Calvert County		Sassafras River		Calvert County		Sassafras River	
Strategy	0	500	0	500	0	500	0	500	0	500	0	500	0	500	0	500
1 (all sites)	0.02	0.92	0.17	1.00	0.01	0.74	0.07	1.00	<.01	0.45	0.04	1.00	<.01	0.04	<.01	0.64
5	0.02	0.97	0.17	1.00	<.01	0.80	0.06	1.00	<.01	0.49	0.03	1.00	<.01	0.06	<.01	0.74
6	0.03	0.99	0.24	1.00	0.01	0.90	0.10	1.00	<.01	0.63	0.07	1.00	<.01	0.10	0.01	0.87