Modified Pollard Transects do not Predict Estimated Daily Population Size for the Secretive Butterfly, Neonympha mitchellii mitchellii French

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MODIFIED POLLARD TRANSECTS DO NOT PREDICT ESTIMATED DAILY POPULATION SIZE FOR THE SECRETIVE BUTTERFLY, *NEONYMPHA MITCHELLII MITCHELLII* FRENCH.

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ABSTRACT. Over two years, we concurrently assessed two populations of Mitchell's satyr butterfly using mark-release-recapture (MRR) and modified Pollard transects (MPT) in order to calibrate the low intensity MPT method to high intensity quantitative MRR population estimates. We found no correlation between daily MRR population estimates and MPT counts. We attribute this to the sedentary behavior of Mitchell's satyr. We strongly suggest that researchers and managers understand the nature of this relationship before interpreting MPT data and other low intensity monitoring methods if these data are used for population management and recovery programs.

Additional key words: Mark-release-recapture, population monitoring, endangered species

Because of simplicity, population assessments using Pollard transects are in widespread use as monitoring tools for butterfly communities (Caldas and Robbins 2003; Thomas 1983) and imperiled species (e.g., Seidl 1999; Mattoni et al. 2001). Relative to the other more quantitative assessment tool in widespread use for estimating butterfly populations, mark-release-recapture (MRR), Pollard Transects are generally billed as a reliable and easy method for estimating population trends over time. As originally defined, the method involves weekly walks along a transect route making counts of butterflies seen within defined limits. Transects are divided into sections related to habitat or management units. Walks are made only when weather conditions satisfy specified minimum requirements (Pollard 1977). These observation counts are a measure of abundance because they are positively correlated with the abundances of individual species as estimated by mark-recapture studies (Pollard 1979).

Although originally intended as an assessment technique for butterfly communities, it has been widely adopted by those monitoring endangered species. Again, because of the ease of implementation and the relative lack of disturbance to imperiled species from handling (Murphy 1988), Pollard transects have been widely adapted by the butterfly conservation community (e.g., Thomas 1983; Seidl 1999; Mattoni et al. 2001; Gross et al. 2007).

For our work with the federally endangered Mitchell's satyr (*Neonympha mitchellii mitchellii* French), we investigated the use of a modified Pollard transect (MPT) relative to time intensive MRR to determine the feasibility of using a less intrusive population monitoring technique to assess daily population trends and status. By generating simultaneous assessments, we assumed that we could calibrate daily MPT data to reflect quantitative estimates based on MRR. Gross et al. (2007) and Haddad et al. (2008) discuss in detail the issues associated with monitoring populations of the closely related subspecies, St. Francis satyr (*Neonympha mitchellii franscisci* Parshall & Kral), in North Carolina. These authors specifically recommend that MPT estimates be calibrated using MRR. Ten years before their recommendation, we did exactly that to determine the relationships for daily population estimates.

METHODS

We conducted field research at two sites in Berrien County, Michigan, U.S.A., during 1997 and 1998 (Szymanski et al. 2004). Blue Creek Fen and Sarett Nature Center are located within the St. Joseph River drainage approximately 3 km apart. Both sites are complex habitat mosaics best characterized as fen habitats over peat, clay and sandy soils in oak-forested river valleys. Blue Creek Fen is a 10.4 ha linear wetland with distinct vegetation communities. Two occupied habitat patches (1.4 ha and 0.9 ha) were assessed as part of this study, separated by 230m of dense shrub carr habitat. Sarett Nature Center includes a 6.8 ha peatland with suitable habitat limited to two distinct areas (1.4 ha and 0.2 ha) separated by 290m of dense shrub dominated carr and swamp forest.

During the summers of 1997 and 1998 we conducted simultaneous evaluations of population trends at two sites. We used MRR to provide a quantitative estimate of Mitchell's satyr population size, demographics and spatial ecology. Each sampling day two people conducted the MRR for approximately 3 hours at each site walking through all suitable habitat patches. The

details of our methods, analyses and discussion of the results are documented in Szymanski et al. (2004).

Concurrently, we used modified Pollard techniques to provide a less time intensive assessment of population trends for Mitchell's satyr. At each fen, we established set transect routes that passed through the occupied habitats patches. The routes were designed to assess all occupied habitat patches and ecotones in each fen. Occupied habitat is limited at both sites (Szymanski et al. 2004) and transects were approximately 175m long at both sites. The same transect routes were used in 1997 and 1998. Transects were performed daily near mid-day for 30 minutes each under favorable flight conditions. We performed our MPT routes either before daily MRR efforts, or at least two hours post MRR at the sites to minimize the potential impact of MRR efforts on butterfly behavior. We counted only butterflies in a forward direction to minimize the possibility of double counting.

For this paper, we used simple correlation analysis by site and by year for all days with both MRR and MPT population estimates to determine if the there was a relationship between the results generated by these two methods.

RESULTS AND DISCUSSION

There are no discernible correlations between population trends for Mitchell's satyr using MRR and MPT (Figure 1, Table 1). The near randomness of the relationship between these two assessment methods is startling, given that both are widely accepted and used for measuring populations (e.g., Brussard et al. 1974; Southwood 1978; Schultz 1998). We believe that our MRR estimates are a reflection of the actual population levels present in the fens during our efforts and these estimates are comfortably robust (Szymanski et al. 2004). On the other hand, butterflies counted on the daily routes on our set transect routes were consistently low. If our MRR estimates reflect reality (and given our relatively high recapture rates we believe they do) for Mitchell's satyr, daily counts generated by MPTs provide no insight into actual population size.

We believe that the ecology and behavior of Mitchell's satyr explains the disparate results produced by MRR and MPT. Mitchell's satyr is perhaps the most sedentary butterfly known in the central United States (Shuey 1997; Gross et al. 2004; Hamm et al., in press). Both sexes spend a considerable amount of time at rest in sedges near low shrubs. When they do fly, their flight is generally low and hidden by tall sedges. During this two year study period, we found that the total distance moved by individuals averaged approximately 35m – indicative of a very sedentary species (Szymanski et al. 2004). Nectar feeding is rare, and neither sex visits flowers on a regular basis (Hamm et al., in press). The few adults typically encountered are generally flushed
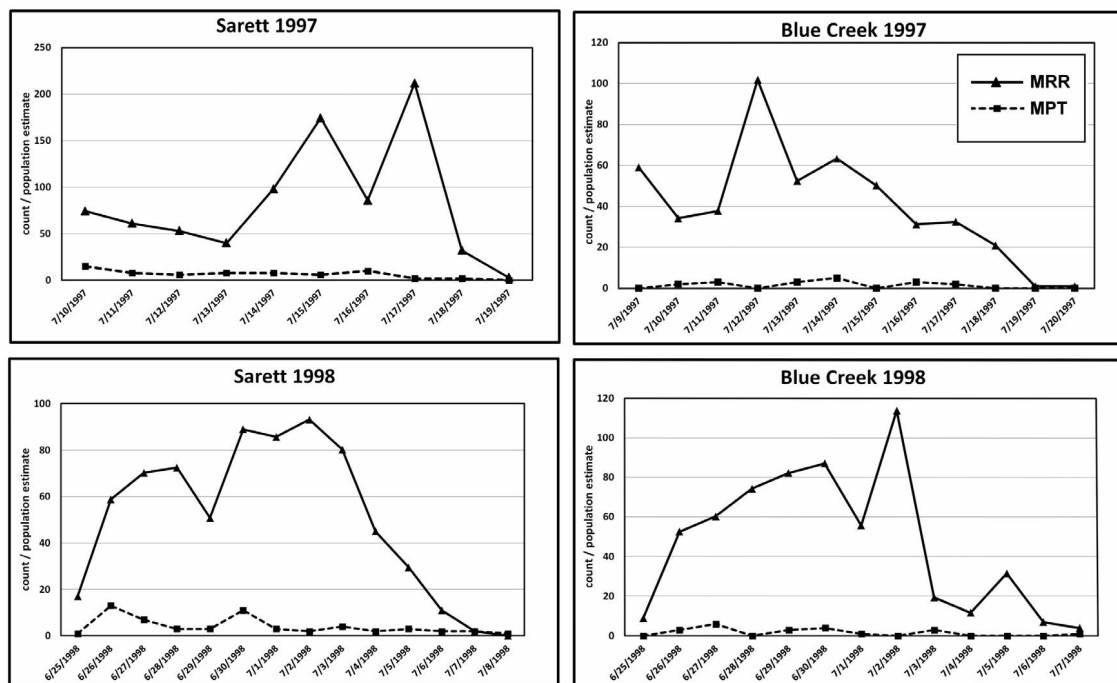

Fig. 1. The daily relationship between MRR population estimates and MPT counts.

out from shaded areas and quickly settle into sedges or shrubs (Shuey 1997). In short, Mitchell's satyr behavior makes it difficult to observe them.

To compensate for this, for our MRR assessment two people canvassed the entire occupied habitat (and adjacent non-habitat edges) for three hours to find, capture, and mark or record as many butterflies as possible. This intense effort was specifically designed to compensate for the sedentary behavior of the butterfly,

and to produce the most accurate population estimates possible by flushing as many adults from the vegetation as possible. MPT efforts were considerably less time intensive and were specifically intended to be the counterpoint to time intensive MRR efforts. One person performed the MPT in 30 minutes on a predetermined route and no attempt was made to flush butterflies from habitats away from the transect route. We expected to encounter fewer butterflies during MPT than we

TABLE 1. **Population assessments (MRR) and transect counts of Mitchell's satyr at two sites in 1997 and 1998. Correlation analysis indicates that there are no significant trends for any of the data sets.** [P is the probability that the two variables are uncorrelated and ranges from 1.0 (no relationship between variables) to values approaching 0.00 (strong non-random relationship between variables). R^2 is the square of the sample correlation coefficient between the outcomes and their predicted values and ranges between 1.0 (perfect correlation between two variable) and 0.0 (no correlation between variables)]

Sarett Nature Center				Blue Creek Fen		
Date	Estimated Daily Population	Transect Count		Date	Estimated Daily Population	Transect Count
				7/9/1997	59.1	0
7/10/1997	74.2	15		7/10/1997	34.2	2
7/11/1997	61.0	8		7/11/1997	37.8	3
7/12/1997	53.1	6		7/12/1997	101.9	0
7/13/1997	39.9	8		7/13/1997	52.5	3
7/14/1997	98.1	8		7/14/1997	63.4	5
7/15/1997	174.4	6		7/15/1997	50.3	0
7/16/1997	85.8	10		7/16/1997	31.3	3
7/17/1997	211.8	2		7/17/1997	32.5	2
7/18/1997	32.0	2		7/18/1997	21.0	0
7/19/1997	3.0	0		7/19/1997	1.0	0
				7/20/1997	1.0	0
P = 0.99				**P = 0.62**		
R^2 = 0.0%				**R^2 = 2.6%**		
6/25/1998	17.1	1		6/25/1998	9.0	0
6/26/1998	58.8	13		6/26/1998	52.5	3
6/27/1998	70.3	7		6/27/1998	60.3	6
6/28/1998	72.5	3		6/28/1998	74.2	0
6/29/1998	50.8	3		6/29/1998	82.2	3
6/30/1998	89.0	11		6/30/1998	87.0	4
7/1/1998	85.7	3		7/1/1998	55.7	1
7/2/1998	93.1	2		7/2/1998	113.8	0
7/3/1998	80.3	4		7/3/1998	19.4	3
7/4/1998	45.0	2		7/4/1998	11.7	0
7/5/1998	29.5	3		7/5/1998	31.5	0
7/6/1998	11.0	2		7/6/1998	7.0	0
7/7/1998	2.0	2		7/7/1998	4.0	1
7/8/1998	0.0	1				
P = 0.11				**P = 0.33**		
R^2 = 20.3%				**R^2 = 8.5%**		

estimated were present. But, in keeping with the literature, we assumed that MPT numbers would be related to MRR estimates, and that our same-day assessments would allow us to calibrate MPT into a tool that provides insight into real Mitchell's satyr populations at the sites.

The two assessment tools produced data that cannot be reconciled for this species at these two sites. Although this has not been previously reported, most researchers have realized that quick habitat assessments do not provide an adequate picture for Mitchell's satyr. In Michigan, more time intensive "meander surveys" are typically used to assess the presence and relative abundance of the species during annual monitoring (Hyde et al. 2001). These meander surveys are specifically intended to flush sedentary butterflies from dense vegetation. Unfortunately, these estimates have not been calibrated to quantitative population estimates either, but because they are standardized relative to the length of observation time, and the observers walk through as much of the occupied habitat as possible to flush butterflies from their perches, intuitively these meander surveys seem much more likely to encounter a higher percentage of resident butterflies.

We urge caution when using Pollard Transects to blindly assess populations and trends of single species. As generally accepted, these assessments generate an index of abundance which is produced for each brood of the species. Pollard (1977) notes that "this index is correlated with abundance, although the precise nature of the relationship will vary from species to species". We caution that the relationship may be weak or non-existent for species such as Mitchell's satyr that have secretive behaviors. We suspect that too often, the exact nature of the relationship between counts generated by MPT and estimated population levels are inadequately explored by people using the assessment tool. Although we did our absolute best to establish transect routes using prevailing best practices as reported in the literature to guide us, our transect counts had little relationship with reality. While Murphy (1988) speculates that the relative densities of butterflies within their habitats can "nearly always be ascertained through simple observation and use of low impact sampling techniques such as that of Pollard (1977)", we believe that this is a gross oversimplification. Managers and researchers must clearly understand the nature of that relationship before interpreting MPT data and other low impact assessment methods (such as meander surveys or distance sampling efforts [Buckland et al. 2001]) for imperiled butterfly species, especially if these data are used for population management and recovery programs.

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