

GRANT AGREEMENT PERFORMANCE REPORT

TO: U.S. FISH AND WILDLIFE SERVICE
SPORT FISH AND WILDLIFE RESTORATION
HADLEY, MA

FROM: MARYLAND DEPARTMENT OF NATURAL RESOURCES
ANNAPOLIS, MD

GRANT AGREEMENT: E-4-19

GRANT TITLE: ENDANGERED SPECIES CONSERVATION

TOTAL COSTS: \$65,131

JOB PERFORMANCE REPORT

State: Maryland

Project Title: Endangered Species Conservation

Job No.: 657

Job Title: Restore and Manage Sandplain Gerardia Habitat

Principal Investigator: Tyndall

Job Objective:

Restore and maintain more than 1,000 acres of sandplain gerardia (*Agalinis acuta*) habitat.

Activities/Findings:

During the period 1 July 2007 - 30 June 2008, about 25 acres of *Agalinis acuta* habitat were cleared of the invasive Virginia pine population in Soldiers Delight Natural Environment Area. Inclement weather precluded the burning of 5 prepared burn units. The annual monitoring survey was completed; the population was 13.7% of the peak count recorded in 1993, probably due to low summer rainfall and deer herbivory.

Helicopter Applicators, Inc. (Gettysburg, Pennsylvania) was contracted to conduct a nocturnal helicopter FLIR survey of the white-tailed deer population on 25 March 2008. Survey equipment included a Kelvin 350II Radiometric Infrared Camera, AgNav computer, and Bell Jet Ranger 206 helicopter. The survey was conducted from 9:45 p.m. to 1:00 a.m. with < 10 mph winds, clear skies, and < 30°F temperatures. The helicopter flew parallel transects at a height of 500 feet and speed of 40 mph. Deer locations were mapped with ArcView GIS (WGS84 datum) and National Geographic Topographical maps. A total of 246 deer were counted for a deer density of 88/sq. mi. About 90% of the deer occurred in groups, most groups consisted of 2-4 deer, and the largest group size was 13. About 80% of the deer were concentrated near forest ecotones. Results will be used to design and implement a managed hunt program with a goal of < 20 deer/sq. mi.

Reasons for deviations (if any):

None.

Recommendations:

Continued funding is needed for further clearing of Virginia pine and prescribed burning of recovered habitat. Enhanced funding is needed for monitoring and managing a rapidly increasing white-tailed deer population and populations of highly invasive non-native plant species such as Tree-of-heaven, Mile-a-minute, and Miscanthus. Annual population surveys of *Agalinis acuta* should result in a better understanding of annual size fluctuations in relation to weather, as well as the effects of excessive deer grazing and invasive plant species.

JOB PERFORMANCE REPORT

State: Maryland

Project Title: Endangered Species Conservation

Job No.: 659

Job Title: Seabeach Amaranth Reintroduction

Principal Investigator: Tyndall

Job Objective:

To reestablish a viable seabeach amaranth (*Amaranthus pumilus*) population on Assateague Island National Seashore.

Activities/Findings:

During the period 1 July 2007 - 30 June 2008, a total of 2,176 plants were documented on the Maryland portion of Assateague Island, with 3 plants found in Virginia. The previous highest count was 1,552 in the preceding year, which included 9 in Virginia. Excessive deer and horse herbivory significantly limit reproductive output and expansion of the population. Plants were not relocated on Tom's Hook in Virginia.

Reasons for deviations (if any):

None.

Recommendations for the continuance of job:

This job should be continued to determine reintroduction success or failure.

JOB PERFORMANCE REPORT

State: Maryland

Project Title: Endangered Species Conservation

Job No.: 661

Job Title: Survey and Monitor Sensitive Joint-vetch Populations

Principal Investigator: Knapp

Job Objective:

To determine the status of sensitive joint-vetch (*Aeschynomene virginica*) in Maryland and to identify critical elements to be included in a conservation/recovery strategy, to provide for the long-term sustainability of the species in Maryland.

Activities/Findings:

During the period 1 July 2007 - 30 June 2008, surveys were conducted for the Eastern Shore populations. The Taylor Branch subpopulation consisted of only 113 plants compared to its annual average of 440 plants. However, the Upper Manokin subpopulation was 3,179 plants, substantially higher than its annual average of 1,666 plants. The difference in subpopulation size was unexpected and not understood.

Reasons for deviations (if any):

None.

Recommendations for the continuation of the job:

Existing subpopulations should be monitored annually to observe invasive species populations and shoreline development projects. Likewise, natural fluctuations in population size will be understood as more population data is collected.

JOB PERFORMANCE REPORT

State: Maryland

Project Title: Endangered Species Conservation

Job No.: 687

Job Title: Monitor Puritan and Northeastern Beach Tiger Beetles

Principal Investigator: Therres

Job Objective:

To monitor the highly sensitive populations of Puritan tiger beetle and northeastern beach tiger beetle occurring in Calvert County and on the Eastern Shore of Maryland and identify potential threats and direct habitat/land use conflicts as shoreline development and stabilization continues along the shores of the Chesapeake Bay.

Activities/Findings:

Work was conducted under contract with Dr. Barry Knisley, Randolph-Macon College. Surveys for adult northeastern beach tiger beetles (*Cicindela dorsalis dorsalis*) and Puritan tiger beetles (*C. puritana*) were conducted at Calvert County and Sassafras River sites in 2007. The results for Calvert County are given in Table 1 and for the Sassafras River in Table 2. Note that during previous surveys in Calvert County, Western Shores and Calvert Beach were counted as separate areas but were combined as one unit in 2006. In addition, the Warrior's Rest section of Scientists Cliffs was counted as a separate unit in Calvert County beginning in 2006.

The *C. d. dorsalis* surveys in Calvert County showed a count of only 767 adults in 2007, indicating a very low but stable population in the past 4 years. There were 760 documented in 2006, 750 in 2005, and 722 in 2004. These were the lowest ever recorded since the surveys were initiated in 1988. Counts in these years indicate a very large decline from > 1,500 to 3,000 totals in the 1999 to 2003 period. Numbers at both remaining sites (Western Shores and Flag Ponds) were similar over the past 4 years.

The total number of adult *C. puritana* found in Calvert County in 2007 was 2,622. This is a decline from last year's total of 3,946. Major changes in 2007 were the result of a decrease from 1,123 to 273 adult beetles at Western Shores and Calvert Beach. All other sites had smaller increases or decreases. Some of the decline in 2007 may be a result of the pattern of alternate year abundance, with most odd number years having smaller counts. This pattern of lower odd year cohort totals in the Calvert population has existed since 1995. These fluctuations in numbers are the norm for *C. puritana* and most other tiger beetle populations, although the low counts in the past 10 years clearly indicate a significant decline from the previous 10 years. This may be due to habitat degradation. The Calvert Beach site continues to decline in habitat quality due to very rapid increase in cliff and back beach vegetation.

The results of surveys for adult *C. puritana* at all sites at the mouth of the Sassafras River in 2007 were a total of 1,566 adults. This is an increase from the 1,250 in 2006 and 424 in 2005. The increase resulted almost entirely at Grove Point from 273 to 843 adult beetles. West Turner increased from 172 to 218, while East Lloyd decreased from 554 to 368. Several other sites decreased also.

Reasons for deviations (if any):

None.

Recommendations for the continuance of job:

This job should be continued at least until such time as the tiger beetle populations have been fully recovered. Annual monitoring of all tiger beetle populations within Maryland is needed to assess changes or threats to the tiger beetle populations.

Table 1. Population census counts of adult *Cicindela dorsalis dorsalis* and *C. puritana* at all Calvert County survey sites during 2007 surveys.

Site	Number of adults	
	<i>C. d. dorsalis</i>	<i>C. puritana</i>
Randle Cliff	0	21
Camp Roosevelt	0	0
Bayside Forest	0	14
Warrior's Rest	0	631
Scientists Cliffs	0	206
Western Shores & Calvert Beach	716	273
Flag Ponds	51	0
Calvert Cliffs State Park	0	292
Nuclear Power Plant	0	276
Cove Point	0	0
Little Cove Point	0	740
Cliffs of Calvert	0	172
	767	2,625

Table 2. Population census counts of adult *C. puritana* at Sassafras River survey sites during 2007 surveys.

Site	Number of adults
Grove Point	843
Ordinary Point	53
North Stillpond	66
West Betterton	6
East Betterton	12
East Lloyd	368
West Turner	218
East Turner	0
	1,566

JOB PERFORMANCE REPORT

State: Maryland

Project Title: Endangered Species Conservation

Job No.: 695

Job Title: Monitor Dwarf Wedge Mussel Populations

Principal Investigator: McCann

Job Objective:

To provide more detailed information on the distribution and relative abundance of the dwarf wedge mussel (*Alasmidonta heterodon*) in the Three Bridges Branch watershed, and continue population monitoring at other streams.

Activities/Findings:

Three Bridges Branch Inventory

We conducted additional surveys during August 2007, as a follow-up to 2006 inventory work, in the Three Bridges Branch watershed, Queen Anne's County, to (1) obtain more detailed information on *A. heterodon* relative abundance and age/size distribution, and (2) more precisely determine the upstream and downstream extent of the population. We conducted snorkel/bucket surveys at seven 100-m long stream sections with a total survey effort of 19.7 person hours.

Surveys yielded a total of 475 live native unionids representing 5 species along with 109 dead shells. *A. heterodon* was present at 5 of 7 sites where we detected a total of 8 live individuals and 19 dead shells. At one of these sites, only dead shells (n = 6) were found. *Elliptio complanata* was, by far, the most common species. It was present at all 7 sites and comprised 98% (465) of all live unionids found and 80% (87) of the dead shells. Although *A. heterodon* is still quite rare in Three Bridges Branch, it was the second most common unionid species, representing 1.7% and 17.4%, respectively, of the total number of live and dead mussels found.

Other unionids found were *Anodonta implicata* (2 live, 1 dead), *Pyganodon cataracta* (1 dead) and *Strophitus undulatus* (1 dead). The latter represents the first record from the Corsica River watershed. *S. undulatus* is the only other state or federally listed species, besides *A. heterodon*, that has been documented in this watershed. The rarity of *A. implicata* and *P. cataracta* was not unexpected; both species tend to occur in slack water and still water areas along slow-moving streams and rivers, as well as impounded waters. These conditions are lacking in Three Bridges Branch. However, the apparent absence of *E. fisheriana*, a watchlist species, was surprising. During 2006 surveys, it was the second most common species in Three Bridges Branch and elsewhere in the Corsica River watershed although it does have a spotty distribution and only represented 2.5% of all live mussels found.

Our 2007 surveys extended the distribution of *A. heterodon* along Three Bridges Branch by approximately 0.5 km further upstream and 0.2 km downstream, for a total occupied stream length of 2.7 km. The upstream limit occurs about 300 m downstream from the Rt. 301 bridge where a single live specimen was found. The stream channel just below this bridge is heavily scoured and consists mostly of deeply gouged pools, probably due to highway runoff. The substrate here is probably too unstable and coarse (mostly large gravel, cobble and clay marl) to support *A. heterodon* and, as our surveys

indicate, most other mussels. The downstream limit of *A. heterodon* along Three Bridges Branch appears to coincide with the upstream end of a broad, open, active beaver impounded section that extends for 0.5-0.7 km along the stream's floodplain. The stream here is highly braided, shallow, warm and turbid due to beaver activity; no mussels of any species were found. Although beaver activity probably provides some long-term benefits to *A. heterodon* and other stream organisms, especially by trapping sediment runoff from nearby farms and increasing overall habitat stream heterogeneity, it appears to have negatively affected the mussel fauna along this particular stream section over the short term.

Our surveys also extended by approximately 0.5 km the upstream limit of *A. heterodon* along an unnamed 1st-order tributary of Three Bridges Branch. Here, *A. heterodon* occurs along a total stream length of 2.8 km, which slightly exceeds the length of known occupied habitat along the main stem of Three Bridges Branch. These survey results now put the total range for the entire Three Bridges Branch and Corsica River watershed at 5.5 km. No live individuals were found at the most upstream survey station along this unnamed tributary but we did collect 6 fresh dead shells and it's likely that suitable habitat extends at least 100-300 m further upstream; unfortunately, we were unable to obtain landowner permission to continue surveys further upstream. Along this uppermost survey station, the stream averages just 1.5 m wide (range = 0.3-3 m) and 20 cm in depth (range = 6-60 cm). This tiny tributary represents the smallest stream in Maryland, and perhaps rangewide, in which *A. heterodon* has been found.

During 2006-2007, we found a total of 23 live *A. heterodon*. Each was marked and then returned to their exact capture location to help facilitate long-term population monitoring. We also measured (length, width, height) and aged each individual. Data on age and size distribution along with relative abundance indicate that a relatively small, sparsely distributed but reproducing population resides in the Three Bridges Branch watershed. Mussel age ranged from 3 to 9+ years (mean = 6.2). The average length, width and height was 37.0 mm (range = 22.5-48.6 mm), 16.8 mm (range = 7.4-26.7 mm), and 18.3 mm (range = 8.0-27.1 mm), respectively. These findings reveal multiple age classes including both very young and fairly old individuals, and a preponderance of mature mussels.

Population monitoring at other Dwarf Wedge Mussel streams

We planned to continue annual monitoring at Browns Branch, Nanjemoy Creek and McIntosh Run during the summer of 2007. However, because of severe drought conditions during 2007, we were concerned that surveys might further stress individuals and that survey results might be inconclusive or compromised. Drought conditions were less severe in Three Bridges Branch where numerous seeps seem to provide more stable flow regimes and recent rains just prior to our surveys helped maintain surface flows. Frequent high water levels during early summer 2008 prevented us from completing the monitoring then. We were, however, able to complete most monitoring in late summer 2008, a summary of which will be provided in the FY09 report.

Reasons for deviations (if any):

No population monitoring was conducted at three streams due to a severe, on-going drought in 2007 and frequent high water levels in early summer 2008.

Recommendations for the continuation of the job:

Population monitoring should be continued. A systematic inventory should be conducted throughout the Herring Run watershed in Caroline County where a single fresh dead *A. heterodon* shell was incidentally found during

the summer of 2007. Additional denovo inventory work is also needed in other streams with potential *Alasmidonta heterodon* habitat. These efforts provide important information on the status, distribution, population trends and viability of the mussel in each stream, and yield valuable insights into potential threats and conservation needs.

JOB PERFORMANCE REPORT

State: Maryland

Project Title: Endangered Species Conservation

Job No.: 697

Job Title: Puritan Tiger Beetle Habitat Restoration

Principal Investigator: McCann

Job Objective:

To restore suitable cliff habitat for puritan tiger beetles on Sassafras River Natural Resources Management Area by controlling encroaching vegetation.

Activities/Findings:

During 2006, habitat restoration in the form of vegetation control (using herbicides and mechanical control) occurred at two puritan tiger beetle cliff sites along the Chesapeake Bay. It is believed that vegetation encroachment on these cliffs has significantly reduced habitat suitability for the beetle. These habitat changes also may have contributed to a major decline in the overall Sassafras River metapopulation, which represents approximately 20% of the world's remaining populations. This first-ever attempt at habitat restoration for the species in the Chesapeake Bay region promises to help bolster the long-term viability of the Sassafras River metapopulation and species as a whole.

To determine the effectiveness of the herbicide treatment and its effects on puritan tiger beetle populations, we collected baseline cliff vegetation and beetle population data in 2006. Post-treatment data collection began in July-August 2007-2008, which we hope to continue annually until at least 2011. Our findings thus far are detailed in a report submitted in August 2008 to the U.S. Fish and Wildlife Service, Chesapeake Field Office entitled "Restoration of Puritan Tiger Beetle (*Cicindela puritana*) habitat at Sassafras Natural Resources Management Area, Kent County, Maryland" by J. M. McCann et al. A summary of the restoration work and beetle response is provided below.

Herbicide treatment at cliffs A and D was very successful in terms of eliminating most cliff vegetation and significantly improving habitat conditions for Puritan Tiger Beetle. Although the effects of cliff vegetation control on beetle abundance should be better known in several years, monitoring results indicate that it has already helped maintain relatively high beetle numbers at the cliff sites during 2007-2008. Annual beetle monitoring through at least 2009-2011 is essential to evaluate beetle response to vegetation control. Likewise, cliff vegetation plot sampling and photo monitoring should be completed again in late summer 2008. Sampling methodology beyond 2008 has yet been determined. This monitoring will not only help us evaluate changes in beetle abundance in relation to cliff vegetation cover but help determine future habitat restoration needs at these cliff sites.

Reasons for deviations (if any):

None

Recommendations for the continuation of the job:

Annual monitoring of beetle populations and cliff vegetation should continue through at least 2011 so that the restoration can be adequately evaluated.

JOB PERFORMANCE REPORT

State: Maryland

Project Title: Endangered Species Conservation

Job No.: 698

Job Title: Harperella Monitoring and Mapping

Principal Investigator: Frye

Job Objective:

To monitor the Harperella populations at all extant locations and to map the exact locations of all populations within their current occupied range.

Activities/Findings:

We mapped 45 transects (30 m in length) along Sideling Hill Creek using GPS waypoints. We captured a metric of landscape complexity by estimating relative cover of all vascular plants on a 9-point scale including those overhanging but not rooted in each 3 x 30 m transect. We captured microsite conditions within Harperella patches (occupied) and outside of Harperella patches (unoccupied) by estimating relative cover of streambed particle sizes in 0.5 m² square plots. (Gravelometer available from Wildco, Wildlife Supply Company, Buffalo, NY, marked with 14 standard USGS sieve sizes). In each transect we specifically searched for any invasive, exotic species.

We used Nonmetric Dimensional Scaling (NMS) to illustrate patterns of plant species and substrate composition in transects occupied by Harperella. Techniques like NMS attempt to locate samples in a low-dimensional ordination space such that the intersample distances in the ordination have the same rank order as do the intersample dissimilarities in the dissimilarity matrix. Additionally we used a Monte Carlo randomization to evaluate whether NMS is extracting stronger axes than expected by chance. A 45 transect x 89 plant species matrix and a 45 transect x 14 substrate size matrix were transformed to distance matrices in NMS ordinations using Sorenson (Bray-Curtis) distance. The 45 transect x 14 particle size matrix was also used as an overlay or secondary matrix to examine correlations of substrates with vegetation ordination scores. A 45 transect Harperella density matrix was used as a second matrix for determining correlations of Harperella density with ordination scores of both vegetation and substrate. We log-transformed Harperella density to improve normality and used the transformed density data along with ordination scores for each transect to examine Pearson (linear, r) and Kendall (rank, tau) correlations.

We used multiple response permutation procedure (MRPP), a nonparametric analog of multivariate analysis of variance to test the hypothesis of no significant differences in substrate composition between occupied and unoccupied habitat. MRPP has the advantage of not requiring assumptions of multivariate normality and homogeneity of variances that are atypical in community data. The probability value expresses the likelihood of finding a difference as or more extreme than the observed difference between groups based on all possible partitions of the data set. We used Sorenson distance on the ranked distance matrix (same as the ordination). We used PC-Ord (v. 3.04, for Windows; MjM Software, Gleneden Beach, Oregon, USA) for all ordination and MRPP statistical analyses. We used SYSTAT (v.12, Systat Software, San Jose, CA) to examine Pearson correlations of density with

ordination scores and to evaluate normality of subsets of variables using Shapiro-Wilk tests.

Our 45 transects represent 1.35 km of occupied habitat containing patches ranging from as few as 4 *Harperella* plants to more than 1,100. Total *Harperella* abundance in our survey was estimated to be 11,088 culms. Within the narrow band of aquatic habitat *Harperella* co-occurred nearly 99% of the time with American Water Willow (*Justicia americana*), a long-known plant associate. In the broader habitat as measured by our belt transects we found no strong patterning of vegetation in our belt transects. *Harperella* subpopulations occur at multiple locations on the landscape along Sideling Hill Creek associated with a wide variety of plant species and vegetation types ranging from emergent and scour bar vegetation to floodplain forests and even graminoid-dominated terraces, shale barrens and forested bluffs. Many vegetation types and their associated habitats are intermingled within transects owing to heterogeneous substrate deposits and a steep moisture gradient. This accounts for the wide variation and lack of strong clustering of plant species along NMS ordination axes.

We found only weak correlations of individual substrate sizes with vegetation ordination axes. This was not surprising given the wide variety of associated plant communities occurring along Sideling Hill. Also, our substrate samplings within transects were set in the densest patches of *Harperella* (to be compared to an unoccupied matrix) that were often dominated by large cobble and bedrock. This produced a homogenizing effect as zeroes for the smaller substrate size classes heavily dominated the ordination matrix.

Harperella density showed no strong associations with vegetation ordination axes, which is consistent with our results that *Harperella* density within habitat patches is driven chiefly by substrate composition. We found a significant correlation between *Harperella* density and the first NMS axis in the substrate ordination. High cover of large diameter substrates, especially exposed bedrock, and fine sediments dominated occupied habitat and held the largest stands of *Harperella* (e.g., abundance >700 stems).

We found significant differences between substrate sizes in occupied versus unoccupied habitat. This difference was mainly due to high relative cover of small diameter substrates (8.0, 11.0, 16.0, 22.6, 32.0, 45.0, 64.0 mm) in unoccupied habitat. Our gravelometer did not make a distinction between large cobble and bedrock, but *Harperella* was more frequently found in fine sediment (2.0 mm) deposits among crevices in bedrock, whereas medium and large cobbles were more frequently found in unoccupied habitats along with small cobble and gravel sized substrates. This may explain the relatively weak difference between occupied and unoccupied habitats in abundance of medium and large cobble/bedrock but the strong difference in cover of sediment: i.e. fine sediments settle between and around intermediate-sized substrate, but are more apparent when they accumulate in bedrock crevices and depressions. Smaller diameter substrates would be more easily transported during flood events and while they may provide habitat during periods of low stream activity (flow) they may never act as habitat for stable stands.

Invasive Species

Harperella co-occurred with 123 other vascular plants with an average of 24 species per transect. Five species: Japanese Honeysuckle (*Lonicera japonica* Thunb.), Rambler Rose (*Rosa multiflora* Thunb. ex Murr.), Nepalese Browntop (*Microstegium vimineum* (Trin.) A. Camus), Small Carp Grass (*Arthraxon hispidus* (Thunb.) Makino), and Creeping Jenny (*Lysimachia nummularia* L.) are considered to be invasive. In particular, *M. vimineum* has long been considered a potential competitor in *Harperella* habitat. Although present in 75.6 % of all transects, *M. vimineum* had generally low cover

(<10%). *M. vimineum* was frequently observed outside the transects in larger stands; however these were usually in partially shaded cobble-bars and sandy floodplains, where Harperella was rarely found. *L. nummularia* occurred in 17.8% of transects, *A. hispidus* occurred in 9% of transects; *R. multiflora* occurred in 9% of transects and *L. japonica* occurred in only 1 transect, all at low cover.

Reasons for deviations (if any):

While mapping individual patches we gathered baseline data on associated plant species and substrate conditions.

Recommendations:

We recommend continuing this work to improve the analysis correlating Harperella density to substrate sizes within occupied and unoccupied habitats. Our original work plan used 0.5 m² plots nested within 30 m transects to estimate relative cover of substrates and we compared this to total Harperella abundance in the transect. These measurements may not be representative of the whole transect. We would continue the work using the same mapped transects but comparing Harperella density within the small quadrat to substrate size cover within the small quadrat.