Conservation and Management of Rare Wetland Butterflies: Strategies for Monitoring, Wetland Enhancement, and Captive Rearing in the Mid-Atlantic Region

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Funds Requested:
Federal Funds Requested: 83,350; Non-Federal Match (including in-kind): 83,350

Project Description:

The status and distribution of many wetland butterfly species is uncertain in several Mid-Atlantic States. Many of these species are considered species of Greatest Conservation Need (GCN) in many or all of the states in which they occur. For some species declines are well documented and may span a decade or more, while others are of concern based on low encounter rates and negative data during recent survey efforts. This may be in part due to threats impacting groundwater wetlands, including outright destruction, habitat degredation and the succession of open wetland habitats to forest or dense shrubland. Additional perceived threats include climate change, and a vulnerability to extirpation from fragmentation and isolation effects resulting in inbreeding depression and reduced population viability.

In response to the declines in many butterfly species across the region, individuals from several Mid-Atlantic States met for the first time in April 2014 to discuss the prospect of creating a GCN butterfly working group with the goal of improving our understanding of the status, distribution and life history requirements of GCN butterflies through coordination at a regional level. While there are many GCN butterflies spanning multiple habitat types, the group decided that the initial focus would be GCN butterflies inhabiting groundwater wetlands, with the primary objective of enhancing and expanding populations of GCN wetland butterflies through developing a greater understanding of the distribution and habitat requirements for these species, followed by habitat improvement projects where needed. To this end we propose a multi-state coordination effort to update distribution and abundance data for GCN wetland butterflies, identify, maintain and enhance wetlands that support GCN butterflies, and develop Best Management Practices (BMPs) for both species and wetland management in an effort to increase the number of colonies for multiple GCN species and promote connectivity between those colonies.

Priority RCN Topic: Our proposal addresses RCN Topic #5: **Design and Implement Conservation Strategies for NE Species of Greatest Conservation Need.**

The project will be conducted in the District of Columbia, Maryland, New Jersey, Pennsylvania, and West Virginia, where many GCN wetland butterflies inhabiting both Piedmont and Montane groundwater wetlands (key wildlife habitats) are thought to be in decline. The range for many of these species spans all participating states. Two-spotted skipper (*Euphyes bimacula*), black dash (*Euphyes conspicua*), dion skipper (*Euphyes dion*), Baltimore checkerspot (*Euphydryas phaeton*), Delaware skipper (*Anatrytone logan*), broad-winged skipper (*Poanes viator*), long dash (*Polites mystic*), Harris' checkerspot (*Chlosyne harrisii*), mulberry wing (*Poanes massasoit*), eyed brown (*Satyrodes eurydice*), silver bordered fritillary (*Boloria selene*), bog copper (*Lycaena epixanthe*), bronze copper (*Lycaena hyllus*) and arctic skipper (*Carterocephalus palaemon*) are amongst those GCN species that have been encountered with less frequency in some states over the last several years (although not every species occurs in every participating state or is listed as a GCN in every state). While the specific factors impacting different species are unknown to a large degree, certain threats, including forest succession and invasive species proliferation, degrade habitat and impact multiple wetland species in a given habitat across the region. Our goal is to increase the number of quality wetland habitats for GCN butterflies in a strategic manner that emphasizes habitat connectivity and potential climate change impacts. Our objectives include updating distribution data for GCN butterflies, identifying and prioritizing locations for management, recommending and implementing specific habitat enhancement activities to improve wetland sites and developing BMPs to improve wetland conditions for populations of wetland butterflies across the range.

Each state will contribute something different to the project, largely because the level of understanding of GCN wetland butterfly status and distribution differs depending on the species and the level of survey effort in the state. In some states there is an identified need for targeted survey work to update historical records and survey wetland habitats for GCN butterflies, and these tasks will be the focus for the 2-year grant period. In other states the distribution of many GCN wetland butterflies is fairly well known, and while survey work will be a major component of the project, those states will also focus on habitat enhancement. Wetland habitat enhancement will be planned, prioritized and initiated, and BMPs for habitat prioritization and management will be determined; these BMPs can later be used by all participating states.

To some extent survey data compilation and on occasion, habitat enhancement, is ongoing in all participating states; but if awarded the grant, work will continue from January 2016 through January 2018, with most field work occurring in the spring, summer and fall months.

Project Objectives and Methodology

The primary objective of the proposed project is to enhance and expand populations of rare wetland butterflies through developing a greater understanding of the distribution and habitat requirements for these species, followed by habitat improvement projects where needed. The actions necessary to achieve this goal include the following:

(1) Identify and map populations of GCN wetland butterflies across the region. DC, MD, NJ, PA and WV will be engaged in this action.

Methods – knowledge of a species distribution is fundamental to its protection and management. We propose to initiate or complete surveys to quantify and map the various species of GCN wetland butterflies and their habitats using standardized methods and field forms (see Appendices I and II). In addition to updating occurrence records and investigating known wetland sites we will use Species Distribution Models (SDMs) to target additional, potential wetland sites for GCN butterflies. These models consider both field data and biological expertise, and rely on landscape-level datasets to statistically analyze the relationship between relevant biotic and abiotic factors with the presence of the species being modeled. SDMs allow for a reasonable prediction of the presence or absence of the species and thus for focused survey work.

The SDMs being considered for use include the GIS-based Predictive Distribution Model (see Guisan & Thuiller 2005 for an overview) and the Maximum Entropy (MaxEnt) Habitat Model. The MaxEnt model has been used successfully to model even rare species with small numbers of occurrence records (Hernandez et al. 2006, Kumar & Stohlgren 2009). Models will be developed by the PA Natural Heritage Program with all states contributing distribution data. All output data from the SDM models will be used to guide on-the-ground survey work.

(2) Prioritize wetland habitats for enhancement work. This will be based on a number of factors, including (a) the presence or absence of GCN butterfly species in a given wetland and the relative size of those populations, (b) the condition of the wetland and the estimated likelihood that it can be successfully enhanced given limitations in time, manpower and funding, and (c) the connectedness of a given wetland to others in the region, important for facilitating dispersal of GCN wetland butterflies. This objective will require cooperative partnerships with private landowners in many cases and will offer an opportunity to pursue conservation measures on private properties. DC, MD, NJ, PA and WV will be engaged in this action.

Methods – Using the distribution data and maps acquired from Objective (1), we will first prioritize those wetland habitats based on the factors described above. We have created field forms to evaluate the condition of a given wetland for GCN butterflies; the forms will be modified over time to permit for a more quantitative assessment but provides a foundation upon which we can build (Appendices II and III). In addition, we will also incorporate available data from other projects for GCN butterfly species, including mark-release-recapture data and climate modeling data, both of which are available to some degree for at least one GCN butterfly, the Baltimore checkerspot. (Baltimore checkerspots are currently listed as a SGCN in MD and PA, and will be upgraded to SGCN status in DC, NJ and WV in the 2015 SWAP revisions.) This information will help to assess dispersal potential for the species as well as determine reasonable distribution patterns given the potential impacts of climate change. Promoting connectivity between populations of GCN butterflies is important in order to avoid inbreeding depression, of concern since many populations of GCN butterflies are apparently small and isolated. Inbreeding depression has repeatedly been shown to have adverse impacts on multiple species, including butterflies (Saccheri et al. 1998, Haikola et al. 2001, Nieminen et al. 2001, Haikola 2003).

Climate models can be used to evaluate and predict current and future climate space for GCN wetland butterflies whose current distribution is reasonably well understood. MaxEnt models are one of several models used to predict the distribution of a species by inferring its environmental requirements (temperature, rainfall, etc.) from localities where it is currently known to occur (Hijmans & Graham 2006). Climate models have been successfully used by Willis et al. (2009) to predict suitable reintroduction sites for two species of butterflies in the United Kingdom in areas that were initially beyond the range of both species. MaxEnt models have already been used by the MD Natural Heritage Program (NHP) to model climate for Baltimore checkerspots in all states in which it is tracked, including DE, NC, PA and others (see NatureServe for a complete list). Knowing projected areas of suitable climate space for GCN butterflies will help target survey and habitat improvement efforts by focusing in those regions with more favorable climate outlooks.

(3) Implement specific wetland enhancement and improvement projects. DC, MD, and PA will be involved in this effort.

Methods – Wetland improvement and enhancement activities may include removing invasive plants through cutting, pulling and treating with herbicides, planting host and nectar plants, installing fencing to protect host plants from deer browse when necessary, and the use of grazing to remove invasive species. Given that establishing new populations and increasing the robustness of small, fragile populations of GCN butterflies is a long-term goal of the project, ensuring wetland suitability is a critical first step in the process. Most if not all successful butterfly introduction attempts in the United States and Europe were preceded by some form of habitat remediation to help ensure long-term survival of the populations (Schweitzer 1994, Pullin 1996,

Witkowski et al. 1997, Shepherd & Debinski 2005, Tolson et al. 2009, Parker 2012, Porter 2012, Linders 2014, John Kanter, NH Fish and Game, pers. comm.). Large-scale restoration activities will be avoided in order to avoid "ground-disturbing" activities that would require NEPA or Historic Preservation Compliance. While we may identify sites that require more intensive restoration, we will not actively engage in such restoration activities as part of this project. We will however, collaborate with other species experts (animal and plant experts) to ensure that even the less intensive enhancement activities proposed do not harm other GCN species inhabiting the targeted wetlands.

(4) Develop Best Management Practices (BMPs) for habitat modeling of GCN wetland butterflies and enhancing wetland habitats for GCN butterflies.

Methods – BMPs will be determined as the project progresses. Some specific examples may include sharing information between states to aid in understanding the distribution and habitat requirements of poorly known GCN butterflies and developing prescriptions for management given specific wetland conditions.

Outcomes and Products

(1) Output from SDM habitat models and MaxEnt climate models will be one of the initial products that will allow for targeted survey work for some GCN species. Maps generated from these models may also allow for a greater understanding of potential species dispersal pathways and potential climate impacts which will guide wetland enhancements and restoration projects, providing benefits to multiple species of GCN butterflies. *Expected products include model output maps and related data.*

(2) Survey work (which would be guided in part by habitat and climate models) will help accumulate updated distribution data for GCN wetland butterflies across the region and allow for an assessment of the condition of wetland sites. This information will provide a foundation for identifying and initiating habitat enhancement projects as well as land protection opportunities. It will also allow for targeted assessments of poorly known GCN butterflies and increase our understanding of their habitat requirements across the region, allowing us to improve and protect appropriate wetland habitat. *Expected products include GIS maps, completed wetland assessment forms and up-to-date Biotics (Natural Heritage Program database) records of GCN species distributions throughout each participating state. The number of sites identified for enhancement and number of land protection actions can be quantified.*

(3) Conditions for GCN butterflies will be improved through regionally coordinated wetland enhancement projects in an effort to improve wetland connectivity across the region, important for facilitating dispersal of GCN wetland butterflies across state lines. These measures may also improve habitat and conditions for other SGCN. *Parameters measured include the number of wetlands or acres of wetlands enhanced and, over time, GCN butterfly population trend data.*

(4) Surveys and habitat management actions on private lands will engage more landowners in conservation opportunities. Collaboration with partners involved in GCN butterfly conservation will allow for additional opportunities for survey, monitoring, and enhancement. *Quantifiable actions include the number of conservation easements, conservation incentive programs for landowners, or habitat conservation plans that result from the project over time. Public interest and public participation can also be tracked to some degree by recording the number of volunteers assisting with survey and habitat improvement efforts (or the number of volunteer hours), as well as the number of collaborating partners, the sustainability of those relationships, and the range and number of actions completed. Evidence of collaboration is somewhat subjective but should nevertheless be noted.*

Budget

The budget for each state is described in the following two tables, the first of which details overall expenditures and documents acceptable match, and the second which breaks down the overall budget by the expenses of each major objective as outlined in the proposal.

Overall Budget Expenditures

	Personal Service	*Fringe*	*Indirect*	*Supplies & Materials*	*Travel*	*Contractual Services*	*In-Kind*	*Total*
District of Columbia								
Federal	2600	650	500	1050	200			5,000
Match	2600	650	500	1050	200			5,000
Maryland								
Federal	1900	475	625	4000	6000	17,000		30,000
Match	9100	2275	3085				15,540	30,000
New Jersey								
Federal	1900	475	625					3000
Match							3000	3000
Pennsylvania								
Federal	14,035	5193	2486	2221	3415	8000		35,350
Match	14,400	1532	10,452	6671	2295			35,350
West Virginia								
Federal	4486	1940	718	163	1757	936		10,000
Match	4486	1940	718	163	1757	936		10,000
Total Federal Request								83,350
Total Non-Federal Match								83,350

Breakdown by Major Objectives

	(1) Identify, Map and Coordinate Info Sharing	*(2) Prioritize Wetlands*	*(3) Wetland Improvement*	*(4) Develop BMPs (Approx. 5% of total budget)*	*Total*
District of Columbia					
Federal	4000	750	0	250	5000
Match	4000	750	0	250	5000
Maryland					
Federal	15,000	1500	12,000	1500	30,000
Match	16,340	3720	9,940	0	30,000
New Jersey					
Federal	2400	450	0	150	3000
Match	2400	450	0	150	3000
Pennsylvania					
Federal	14,626	7991	10290	2443	35,350
Match	12,646	3175	16788	2741	35,350
West Virginia					
Federal	8000	1500	0	500	10,000
Match	8000	1500	0	500	10,000
Total Federal Request					**83,350**
Total Non-Federal Match					**83,350**

Summary

Our main objective is to enhance and expand populations of GCN wetland butterflies through survey, modeling, and habitat improvement projects. Habitat improvement projects will be coordinated and prioritized in order to improve connectivity between wetlands in an attempt to allow populations of GCN butterfly species to interact and interbreed with other populations of the same species. Our long-term objective is to create and maintain genetically robust populations of GCN wetland butterflies that are able to traverse the fragmented landscape of the Mid-Atlantic Region, especially if climate change forces regional population shifts.

Key Personnel and Cooperators – STATE AGENCIES

District of Columbia – Damien Ossi, Fish & Wildlife Biologist, DC Department of the Environment, Fisheries and Wildlife Division. Damien has worked for the DDOE for eight years performing inventory and monitoring surveys of dragonflies, butterflies, and other invertebrates, and acting as the District's invasive plant liaison to federal and conservation partners. Damien is also currently the president of the Mid-Atlantic Invasive Plant Council. Damien earned a Bachelor of Arts Degree in Biology from St. Mary's College of Maryland and a Master of Science Degree in Environmental Management from Duke University.

Maryland – Jennifer Frye, Invertebrate Ecologist, MD Department of Natural Resources, Natural Heritage Program. Jennifer has worked as the ecologist for the Maryland NHP for over nine years, conducting inventory, monitoring and research activities for rare, threatened and endangered invertebrate species throughout the state. She also oversees the Baltimore Checkerspot Recovery Team of Maryland. Jennifer earned a Bachelor of Science Degree in Biology from Brooklyn College (City University of New York) and a Master of Science Degree in Environmental and Forest Biology with an emphasis in Entomology from the College of Environmental Science and Forestry (State University of New York).

New Jersey – Robert Somes, Senior Zoologist, New Jersey Department of Environmental Protection, Division of Fish and Wildlife, Endangered and Nongame Species Program. Robert has worked for the NJ DEP for 8 years, conducting field studies for rare, threatened and endangered invertebrate species and developing and implementing habitat enhancement projects for rare invertebrate species. He has extensive experience in research related to, surveying for, and identification of Lepidoptera, Odonata, and freshwater mussels. Robert earned a Bachelor of Science Degree in Environmental Studies from Stockton University and a Master of Science Degree in Ecology and Evolution from Rutgers University.

Pennsylvania – Betsy Leppo, Invertebrate Zoologist, Pennsylvania Natural Heritage Program, Western Pennsylvania Conservancy. Betsy has worked for WPC for almost 19 years, conducting field studies for rare, threatened and endangered invertebrate species, carrying out research, working with landowners and analyzing data. She has extensive experience in surveying vernal pool faunal communities and in research involving Lepidoptera. Betsy earned a Bachelor of Arts Degree in Ecology and Languages from Juniata College and a Master of Science Degree in Biology from Shippensburg University.

Pennsylvania – Christopher Tracey, Conservation Planning Coordinator, Pennsylvania Natural Heritage Program, Western Pennsylvania Conservancy. Christopher has worked for WPC for over 10 years as an ecologist and a conservation planner. He has led many of WPC's database creation and modeling projects and will be modeling the distributions for numerous GCN species as part of PA's SWAP revision process. He is also the lead for Pennsylvania NHP in integrating with the NatureServe modeling network, which is currently under development. Christopher earned a Bachelor of Science Degree in Ecology and Evolution from the University of Pittsburgh and a Master of Science Degree in Conservation Biology from Bowling Green State University.

West Virginia – Susan Olcott, Regional Wildlife Diversity Biologist, West Virginia Division of Natural Resources, Natural Heritage Program. Susan has been a WV DNR biologist since 1995 with the Wildlife Diversity Unit. She earned a Bachelor of Science Degree in Wildlife Management from the University of Maine and a Master of Science Degree in Wildlife Management from Frostburg State University. Her work includes surveys for a variety of taxa including birds, dragonflies and damselflies, moths and butterflies, mammals, and plants; education work with school and civic groups; writing articles; and helping citizens with wildlife problems and questions. She was project leader for the WV Dragonfly and Damselfly Atlas, is currently a regional coordinator for the WV Breeding Birds Atlas, and is heading up the WV Butterfly Atlas.

Literature Cited

Haikola, S. 2003. Effects of inbreeding in the Glanville fritillary butterfly *(Melitaea cinxia). Annales Zoologici Fennici* 40:483-493.

Haikola, S, W Fortelius, RB O'Hara, M Kuussaari, N Wahlberg, IJ Saccheri, MC Singer & I Hanski. 2001. Inbreeding depression and the maintenance of genetic load in *Melitaea cinxia* metapopulations. *Conservation Genetics* 2:325-335.

Hernandez, PA, Graham, CH, Master, LL & DL Albert. 2006. The effect of sample size and species characteristics on performance of different species distribution modeling methods. *Ecography* 29:773-785.

Hijmans, RJ & CH Graham. 2006. The ability of climate envelope models to predict the effect of climate change on species distributions. *Global Change Biology* 12(12):2272-2281.

Kumar, S & TJ Stohlgren. 2009. Maxent modeling for predicting suitable habitat for threatened and endangered tree *Canacomyrica monticola* in New Caledonia. *Journal of Ecology and Natural Environment* 1(4):94-98.

Linders, M. 2014. Reintroducing Taylor's checkerspot: descent and rebirth of the dark sister. Presentation. Conservation and management of three imperiled West Coast butterflies: Bay, Quino and Taylor's checkerspots (Workshop). Alviso, CA.

Nieminen M, MC Singer, W Fortelius, K Schöps & I Hanski. 2001. Experimental confirmation that inbreeding depression increases extinction risk in butterfly populations. *American Naturalist* 157(2):237-244.

Parker, R. 2012. Monitoring a translocation of silver-studded blue in Suffolk. *Antenna (Bulletin of the Royal Entomological Society)* 36(1):32-35.

Porter, K. 2012. Restoring the marsh fritillary butterfly to Cumbria. *Antenna (Bulletin of the Royal Entomological Society)* 36(1):42-49.

Pullin, AS. 1996. Restoration of butterfly populations in Britain. *Restoration Ecology* 4(1):71-80.

Saccheri IJ, M Kuussaari, M Kankare, P Vikman, W Fortelius & I Hanski. 1998. Inbreeding and extinction in a butterfly metapopulation. *Nature* 392:491-494.

Schweitzer, DF. 1994. Recovery goals and methods for Karner blue butterfly populations. *In* Andow, DA, RJ Baker & CP Lane (Eds), Karner Blue Butterfly: A Symbol of a Vanishing Landscape. St Paul: Minnesota Agricultural Experimental Station, Miscellaneous Publication Series. pp 185-193.

Shepherd, S & DM Debinski. 2005. Reintroduction of regal fritillary (*Speyeria idalia*) to a restored prairie. *Ecological Restoration* 23(4):244-250.

Tolson, PJ, ML Magdich & CL Ellsworth. 2009. Return of a native: reintroduction of the Karner blue butterfly to the oak openings of northwest Ohio. Connect Magazine: A publication of the Association of Zoos and Aquariums. October Issue 2 pp.

Willis, SG, JK Hill, CD Thomas, DB Roy, R Fox, DS Blakeley & B Huntley. 2009. Assisted colonization in a changing climate: a test-study using two UK butterflies. *Conservation Letters* 2:45-51.

Witkowski, Z, P Adamski, A Kosior & P Plonka. 1997. Extinction and reintroduction of Parnassius apollo in the Pieniny National Park (Polish Carpathians). *Biologia, Bratislava* 52(2):199-208.