Assessing Priority Amphibian & Reptile Conservation Areas (PARCAs) and Vulnerability to Climate Change in the North Atlantic Landscape Conservation Cooperative

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Funds Requested: **$298,628***

***This amount is contingent upon authorization to use indirect rates for MCFWRU rather than UMaine, and for CESU rather than UGA, respectively. With WMI, rather than USFWS, serving as the fiduciary but not (as far as we can tell) a participant in the Cooperative Units, we are awaiting authorization to honor the CU rates. The authors are exploring every avenue to keep the indirect costs lower; any assistance from the NA-LCC to facilitate the use of the CU and their rates would be greatly appreciated.**

Project Summary: Amphibians and reptiles are experiencing severe habitat loss throughout North America; however, this threat to biodiversity can be mitigated by identifying and managing areas that serve a disproportionate role in sustaining herpetofauna. Identification of such areas must take into consideration the dynamic nature of habitat suitability. As climate rapidly changes it is possible that areas currently deemed suitable may no longer be so in the future. *To address these needs, we are proposing to generate spatially-explicit data that will (1) identify Priority Amphibian and Reptile Conservation Areas (PARCAs) – those discrete areas most vital to maintaining reptile and amphibian diversity, (2) project regions of current and future climatic suitability for a number of priority reptiles and amphibians in the North Atlantic Landscape Conservation Cooperative, and (3) identify gaps in distributional data for these species that may prevent or inhibit the identification of species-level climatic suitability.*

Objective 1, identification of PARCAs will proceed by collecting natural history information, distributional data, and by weighing expert opinion for key species. Objectives 2- 3 will rely on collection of known locality data and the use of inductive species distribution modeling. Collectively, this process will take place over three years (January 2012 – December 2014), and will represent the assembling and processing of all necessary information for identifying PARCAs. Collectively, these approaches will offer a long-term assessment of resiliency of PARCAs identified with respect to those that may provide refugia as the climate changes.

Project Narrative

Introduction

Given limited conservation resources, the need to prioritize specific geographic areas for conservation action that maximizes cost-effectiveness is more important than ever. Incorporating future climate vulnerability projections into analyses for high priority conservation areas allows for improved, long-term ecological planning and adaptive management. Climate change, in conjunction with threats such as land use change, disease, and habitat degradation, is predicted to seriously alter global biodiversity patterns[1]. For many species, the "fingerprint" of climate change can already be detected through shifts in range and phenology. For example, Parmesan and Yohe[2] detected an average poleward shift of 6.1 km per decade for organisms as diverse as birds, butterflies, and alpine herbs. Given the strong correlation between climate and the distribution of some ectotherms[3], it is reasonable to believe that climate change may have especially strong effects on taxa[4] such as reptiles and amphibians.

Because of these needs and anticipated effects, we propose to implement Priority Amphibian and Reptile Conservation Area (PARCAs) criteria[5], developed and peer-reviewed via the national PARC expert network (a methodology informed by scientific criteria for exceptional species diversity and rarity, and local expert review), throughout the North Atlantic Landscape Conservation Cooperative (NA-LCC). We will generate spatially-explicit projections of current and future climatic suitability for a number of priority reptiles and amphibians in the NA-LCC, as determined by the Northeast Partners in Amphibian and Reptile Conservation (NEPARC), and will summarize these results with respect to lands under state and federal management. As part of this process, we will identify gaps in distributional data for these species that may prevent or inhibit the identification species-level climatic suitability. Finally, we will synthesize these results to provide an assessment of climate sensitivity, or future resiliency, of the current identified PARCAs.

An existing effort currently underway through PARC partners in the South Atlantic LCC also implements the PARCA criteria. This common theme of identifying PARCAs provides comparable cross-LCC data layers resulting from a national set of PARC-produced criteria for identifying areas of exceptional herpetofaunal diversity.

Which of the Priority LCC topics does this proposal address?

The NA-LCC Science Strategy identifies "Components and Goals" of the LCC that include "Ecological Planning and Conservation Design". Our vulnerability assessment facilitates long-term ecological planning and conservation design by focusing on species that already have been identified as priorities by NEPARC[5], and will be used in the identification of PARCAs. By selecting species in this fashion, the PARCA identification process will be able to assess the long-term climatic suitability of proposed areas with respect to species of highest management priority.

More specifically, this proposal is responding to three of the top twelve priorities (two within the top three priorities) established by the NA-LCC. In Handout 13 ("Common Science Needs by Rank"), the second-leading priority is to conduct general climate change vulnerability assessments for northeastern wildlife habitats and species. Under this priority, the LCC has specifically identified spatially-explicit modeling as a method for addressing the scientific need. The third-ranked priority is to conduct specific vulnerability assessments of northeastern

amphibians and reptiles. The 12th ranked priority is to identify focal areas for conservation in the Northeast. This proposal will address all of these priorities by identifying gaps in distributional data and currently important conservation areas for amphibians and reptiles, as well as future climate vulnerability assessments for priority species and their associated habitats in the North Atlantic Landscape.

In what area or state(s) will your project be conducted?

We will conduct this assessment for priority herpetofaunal species across the NA-LCC; however, to maximize the utility of this project, we will not clip projections of future climatic suitability at the borders of the LCC. In many cases, the current and future zones of climatic suitability for species of interest will include political and biogeographic units that are within, but extend beyond, the NA-LCC boundary. By including the full complement of spatial information in our final products, we will facilitate cooperation between the NA-LCC and adjacent LCCs and states. Facilitation of conservation goals among such regional units is a stated part of the NA-LCC's Vision and Mission as articulated in the LCC's Science Strategy document.

NOTE:

An existing effort currently underway through PARC partners in the South Atlantic LCC also implements the PARCA criteria. This common theme of identifying PARCAs using nationally-derived PARC guidance criteria provides comparable cross-LCC data layers.

This proposal can serve as a model that could be adapted for any LCC across the country, with costs varying based on number of species desired for modeling and institutional differences in indirect cost policies.

What is the start date of the project and the projected end date?

Start date: January 01, 2012

End date: December 31, 2014

What is the goal of your project and what major objectives or tasks will you undertake to achieve that goal?

The goals of the proposed project are to (1) implement PARCA criteria to identify current high priority conservation areas; (2) conduct a spatially-explicit climate vulnerability assessment for high priority species in the NA-LCC, including identification of data-deficient species; (3) use the climate vulnerability assessment results in a final analysis to determine future climate sensitivity of PARCAs identified. These will be accomplished through the following **six** objectives:

Objective 1*: Work directly with state fish and wildlife agency personnel throughout the NA-LCC states to gather data toward PARCA criteria review and proposed conservation area identification.*

Objective 2*: Provide spatially-explicit maps of current and future climatic suitability for priority amphibians and reptiles in the NA-LCC region, and then use these data a) to rank species vulnerability to climate change based projected losses in the species' ranges, and b) to identify areas within the NA-LCC where either there are high losses of vulnerable species or there is high potential for climatic refugia for priority species, and c) identify species for which this Objective cannot be completed due to gaps in current known distributional data and thus identifies priorities for species data acquisition.*

Objective 3*: Summarize these results with respect to species occurring on lands under current state and federal management.*
Objective 4: *Conduct an analysis of candidate PARCAs to help identify those highest priority conservation areas supporting reptiles and amphibians in the Northeast that are not currently protected.*
Objective 5*: Incorporate climate vulnerability projections into final PARCA analysis, including a ranking of high priority current and future conservation areas.*
Objective 6: *Communicate results to key state, federal, and NGO partners via publications and a Northeast regional workshop.*

What are the methods by which you propose to carry out the work?
Objective 1. USGS-Maine Cooperative Fish and Wildlife Research Unit (MCFWRU) scientists will contact personnel in charge of herpetofauna management at the state fish and wildlife agencies throughout the NA-LCC states to gather natural heritage, atlas, and other point location distribution data toward PARCA criteria implementation, with attention to data sensitivities for the purposes of reporting. Other point data will be gathered through the publically accessible museum database portal HerpNet. To the extent that such data is available and forthcoming from state partners, the MCFWRU scientists will use the published PARCA model criteria (see Appendix) for designating eligible proposed conservation areas drawing on the scientific concepts of species rarity, richness, endemicity, and landscape integrity.
Objective 2. University of Georgia (UGA) scientists will construct species distribution models for species identified by NEPARC as High Regional Responsibility. These models will be generated using the data gathered in Objective 1, in collaboration with MCFWRU scientists, and with a goal of obtaining as many locality records (latitude/longitude coordinates) as are required for each modeled species to create a comprehensive and representative depiction of the species current climatic/ecological tolerances. In addition to the NEPARC list, we will also model amphibians and reptiles (excluding sea turtles) that were not included in the regional-scale NEPARC high priority designation, but listed by NatureServe as having a Global Rank from 1 – 3, as well as those species with a state or federal designation of Threatened or Endangered and having a range that overlaps with the NA-LCC. Species for which data are deficient will represent priority species for future data acquisition.

The UGA scientists will use an inductive, presence-only modeling approach to model species' climatic distributions via program MaxEnt. While many techniques are available for modeling the distribution of species, MaxEnt has consistently proven to perform as well or better than other approaches[6]. In addition, many of the other techniques that perform well, such as logistic regression and RandomForests[7], were explicitly developed to use presence-absence data. Very few (if any) amphibian and reptile species have reliable data on presence and absence throughout the species' range. As a result, a presence-only approach such as MaxEnt is most appropriate. Finally, the use and misuse of MaxEnt has been reported on in nearly 200 peer-reviewed papers since 2006. Such a high implementation rate means the tool is well-vetted, and that many of the early pitfalls of its implementation have been acknowledged and can be avoided in the proposed application.

The current climatic relationships species exhibit will be projected onto downscaled climate change models that are based on two different CO_2 emissions scenarios (the B2a "medium" and A2a "high" scenarios) as generated by two different general circulation models or GCMs (Met Office's Hadley Centre and the Canadian Centre for Climate Modelling and

Analysis). The current climate averages and the projected climate change data have been downscaled at approximately 1 km^2, and this will also be the grid cell size of our models of climatic suitability. We will evaluate three different thresholds for identifying whether or not a particular climate is suitable, representing a range from conservative to liberal estimates (i.e., some are more inclusive of a broader range of species climate tolerances than others). The two CO_2 futures crossed with two GCMs and three thresholds will yield a total of 12 binary models evaluated for each of the species. The 12 models will allow us to explicitly represent model uncertainty, which is a vital parameter in stakeholder decision making.

Objective 3. The UGA scientists will overlay resulting projects onto the Protected Areas Database and similar spatial data layers showing areas under state and federal ownership in order to provide a rank summary of vulnerability allowing for geographic prioritization of land management.

Objective 4: The MCFWRU scientists will identify existing gaps in the protected land network for proposed PARCAs identified in Objective 1.

Objective 5: The MCFWRU scientists will use the spatially-explicit climate vulnerability projections and rankings to create a final PARCA report, including assessment of climate sensitivity of PARCAs identified, with a ranking of high priority current conservation areas as well as areas to target future conservation efforts. As part of this process, we will examine other published work regarding terrestrial landscape prioritization, sustainability, or resiliency (e.g., Anderson and Ferree[8]) to incorporate them to the degree and extent that they are relevant. In addition, we will provide recommendations for application of these spatially-explicit results to on-the-ground conservation and management actions.

Objective 6: The Project Director and all Co-PIs will convene a workshop among key state, federal, and NGO partners (perhaps at the 2014 NEAFWA conference or other regionally-relevant meeting of Northeast stakeholders) to communicate results and discuss potential applications in relation to conservation and management actions; we also will prepare one or more manuscripts suitable for scientific journal publication.

Timeline: Objectives 1, 2, and 3 will occur simultaneously in Years 1-2; Objectives 4, 5, and 6 will occur in Years 2-3.

What measureable products or outcomes will result from your project?

This project will ultimately produce **nine (9)** different products:

(1) A set of PARCAs based on current known species distributions and landscape conditions will be produced, including spatially-explicit maps of these PARCAs. (Primary lead is MCFWRU.)

(2) Spatially-explicit projections of climatically suitable areas in 2050 for high priority species. This time horizon represents a period that is sufficiently far enough into the future for species to experience shifts in climate envelopes, but not beyond the timeline over which long-term conservation planning is typically done. These projections will include six different depictions of climatic suitability for each species under two different CO_2 scenarios. This approach addresses the uncertainty that is inherent to models of climate change and the associated ecological response; areas where model agreement is high represent zones of greater confidence in outcome (Fig. 1). (Primary lead is UGA.)

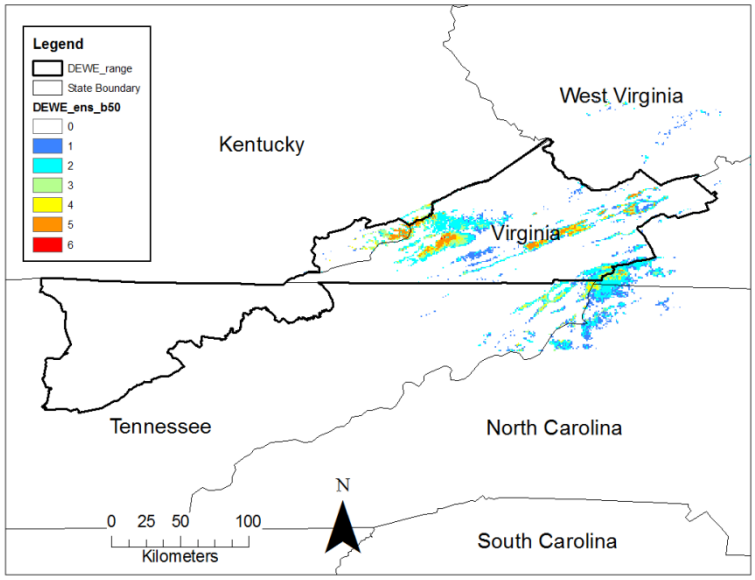

Fig. 1. *Desmognathus welteri* (Black Mountain Dusky Salamander) suitability in 2050, B2a (low emissions) scenario. Three thresholds of climatic suitability were generated under two general circulation models of climate change; so, the above map represents the output of six possible futures. The numbers (0 - 6), and corresponding colors (white - red), indicate the sum of modeled futures that overlap for a particular area. For example, a patch of red indicates all 6 of the models agree the area will remain climatically suitable, but a patch of dark blue is a zone where only one model suggests climatic suitability for the species in 2050. Areas where more than one model overlap are zones of increased confidence in model output.

(3) A table that ranks high priority species based on the amount of climatically suitable habitat they are projected to lose by 2050 under various climate change scenarios. This ranking will provide a tool for conservation decision making. (Primary lead is UGA.)

(4) Maps that represent the change in species richness (where species ranges are based on climatic suitability) between current estimates and estimates for 2050, including an assessment of areas (a) where loss of a number of important species is expected to be high versus low and (b) where this expectation has high versus low confidence based on a number of model scenarios. (Primary lead is UGA.)

(5) A descriptive table providing, by state, a comprehensive documentation of available locality data for each priority species, including localities from academic institutions and Natural Heritage databases. This list will help meet one of the priority science needs identified by the NA-LCC: to identify gaps in distribution data for amphibians (and reptiles), and it will demonstrate areas within the species' distribution that are data-deficient and requiring additional survey effort. (Joint effort among Project Partners.)

(6) An analysis to identify existing gaps in the protected land network for proposed PARCAs identified. (Primary lead is MCFWRU.)

(7) An assessment of long-term viability of PARCAs based on climate projections, including existing studies from the North Atlantic LCC area that address species and landscape resiliency. (Joint effort among Project Partners.)

(8) A final report, suitable for one or more scientific journal publications, summarizing products (1) – (7), and including maps produced in these products. This report will include recommendations for how to apply these spatially-explicit results toward on-the-ground conservation and management actions. (Joint effort among Project Partners.)

(9) A workshop at a regional gathering of Northeast stakeholders in state and federal agencies as well as relevant NGOs where the Project Partners will present results and discuss potential applications in relation to conservation and management actions. (Primary lead is AFWA.)

Literature Cited

[1]Pereira, H.M. et al. 2010. Science 330:1496-1501; [2]Parmesan, C and G. Yohe. 2003. Nature 421:37-42; [3]Buckley, L.B. and W. Jetz. 2007. Proc. Royal Soc. B 274:1167-1173; [4]Aragon, P. 2010. Animal Conservation 13:363-373. [5] NEPARC. 2010. Northeast Partners in Amphibian and Reptile Conservation (NEPARC). Publication 2010-1. [6] Elith, J. et al. 2006. Novel methods improve prediction of species' distributions from occurrence data. Ecography 29:129-151. [7] Elith et al. 2008. Journal of Animal Ecology 77:802-813; [8]Anderson, M.G. and C.E. Ferree. 2010. PLoS ONE 5(7): e11554.

Budget

See attached Budget worksheet.

PROJECT TITLE: Assessing Priority Amphibian & Reptile Conservation Areas (PARCAs) and Vulnerability to Climate Change in the North Atlantic Landscape Conservation Cooperative
PROJECT DIRECTOR: Priya Nanjappa, M.Sc.
Co-PIs: Drs. Kyle Barrett, Nate Nibbelink, John Maerz, Cyndy Loftin, and Phillip deMaynadier
PROJECT PERIOD: January 1, 2012 - December 31, 2014

DESCRIPTION		Jan-Dec 2014	MATCH	NOTES
SALARY				
Dr. Kyle Barrett - UGA Postdoctoral Research Assistant (full time @$39K/year + 42% fringe; no salary match)		$55,380	$0	
Dr. John Maerz - UGA Associate Professor (0.5 month/year @ $3563 + 27% fringe; no salary match)		$4,525	$0	
Dr. Nate Nibbelink - UGA Associate Professor (0.5 month/year @ $3090 + 27% fringe; no salary match)		$3,924	$0	
Maine Cooperative F&W Research Unit (MCFWRU) Postdoctoral Research Assistant (full time @$50K/year + 44% fringe; no salary match)		$144,000	$0	
Dr. Phillip deMaynadier - Maine DIFW Wildlife Biologist (0.5 month/year for 2 years @ $4,755/month + 45% fringe; no salary match)		$5,894	$0	
Priya Nanjappa - AFWA, Project Director (0.75 month/year @ $5080 + 26% fringe; fully burdened;0.75 month/year salary match provided)		$15,836	$15,836	
TOTAL PERSONNEL (UGA + AFWA)		**$229,559**	**$15,836**	
TRAVEL				
UGA Travel at $1000/person for up to 2 personnel for 1 year		$2,000	$0	
MCFWRU Travel at $1000/person for up to 2 personnel/year; cost of vehicle rental+ gas ($2500) offered as match for postdoc travel		$4,000	$2,500	
AFWA/State Travel at $1000/person/year; $1000 travel match provided by Project Director + $1000 travel match tentatively committed (pending quorum-based vote) by NE PARC		$3,000	$2,000	$1000 of this travel match is tentatively provided by NE PARC, pending vote (with quorum) by the NE PARC Steering Committee
TOTAL TRAVEL		**$9,000**	**$4,500**	
OPERATING				
UGA Computer storage and publication costs		$2,400	$0	
MCFWRU Workstation, data storage, software, publication costs ($4500/year)		$9,000	$0	
AFWA-led Workshop to present results to partners in 2014		$3,000	$0	
TOTAL OPERATING		**$11,400**	**$0**	
TOTAL UGA DIRECT COSTS		**$68,229**	**$0**	
UGA INDIRECT COST (RATE*TDC)	17.50%	**$11,940**	**$14,669**	If the indirect cost rate cannot be lowered (either through a CESU agreement - which may be impacted by money coming through WMI, not currently a CESU participant - or via ongoing internal UGA efforts), this amount in unrecovered IDC (39 -17.5%) will have to be added to the total request
TOTAL MCFWRU DIRECT COSTS		**$157,000**	**$2,500**	
MCFWRU INDIRECT COST (RATE*TDC)	15.00%	**$23,550**	**$43,646**	If the indirect cost rate cannot be lowered (through a CU agreement - which may be impacted by money coming through WMI, not currently a CESU participant), this amount in unrecovered IDC (42.8 - 15%) will have to be added to the total request
MCFWRU - USGS interagency transfer rate	6.00%	**$10,833**	**$0**	This is an Bureau-level IDC requirement; not CU-level; it cannot be waived
TOTAL AFWA DIRECT COSTS		**$21,836**	**$17,836**	
AFWA INDIRECT COSTS	24.00%	**$5,241**	**$4,281**	
TOTAL COSTS		**$298,628**	**$82,931**	

TOTAL MATCH PROVIDED	**$82,931**
TOTAL REQUESTED FUNDS	**$298,628**
TOTAL PROJECT COST	**$381,559**

APPENDIX

Model Criteria and Implementation Guidance for a Priority Amphibian and Reptile Conservation Area (PARCA) System in the US

Revised Draft, May 2011

Prepared by National PARC's "Priority Amphibian and Reptile Conservation Areas" Task Team:

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Introduction:

Amphibians and reptiles are experiencing exceptional population declines in North America, with habitat loss and fragmentation among the leading threats to both groups. However, important habitats for amphibians and reptiles rarely receive sufficient attention from conservation agencies and nonprofit organizations. In this document, we present a set of model criteria and implementation guidelines that can be used for designation of Priority Amphibian and Reptile Conservation Areas (PARCA's) in each state. The goal of a PARCA system is to identify valuable habitat for priority herpetofauna (amphibians and reptiles) throughout the U.S. using a system informed by scientific criteria and expert review. Model criteria draw on the scientific concepts of species rarity, richness, endemicity, and landscape integrity as tools for shaping the boundaries of proposed PARCA's. It is anticipated that each regional Partners in Amphibian and Reptile Conservation (PARC) organization will form a task team to take charge of the PARCA selection process for individual states within their region. By introducing the PARCA concept, model selection criteria, and a proposed organizational structure for implementation, this document is intended to stimulate greater emphasis on priority herpetofauna within state and national landscape conservation efforts.

We believe that successful designation of PARCA's in each state will yield major benefits for the conservation of amphibians and reptiles. First, the PARCA system will help raise the profile of selected high-priority amphibian and reptile species, and herpetofauna generally, thereby serving as place-based opportunities for increasing public awareness of an underappreciated component of our natural heritage. Second, a PARCA system will help address leading threats to US herpetofauna, including habitat loss and habitat degradation through fragmentation, invasive species, and disease among other factors, by identifying new or expanded areas of the landscape where active land conservation and management by cooperating landowners, land trusts, municipalities, state agencies, and other partners can conserve some of the best remaining populations of priority amphibians and reptiles nationwide. Notably, PARCA's are not designed to compete with existing landscape biodiversity initiatives but rather to complement them – providing an additional spatially explicit layer for conservation consideration.

With efforts initiated in 2007, the national PARCA Task Team has worked to produce a draft set of model criteria and associated implementation guidance that can be used for designation of PARCA's in every state, preferably with oversight by each of PARC's five regional chapters. In 2009, the PARCA Task Team solicited reviews from expert herpetologists and biologists across the U.S, and revised the current draft to incorporate a number of valuable suggestions. While

the proposed science-based PARCA selection criteria are intended to provide consistency to the PARCA selection process by providing uniform standards, they are also designed to be flexible at the regional scale so that specific quantitative thresholds associated with any nominating criterion can be modified to better fit inherent zoogeographic variation among the nation's biophysical regions. As such we believe the proposed PARCA criteria and implementation guidance is now ready for application by regional PARC Chapters around the country. Additional improvements and modified guidance is expected and invited as the system matures.

We recognize that mapping important areas for amphibian and reptile conservation may incur some risk of increasing the threat posed to selected local populations of over-exploited species by unscrupulous and/or illegal collectors. However, we also recognize the grave and immediate dangers posed by habitat loss and habitat degradation to many of the same amphibian and reptile populations, and suggest that in many cases the conservation benefits of public recognition and improved landscape protection and stewardship outweigh potential risks associated with illegal collection. Nonetheless, we have included several mechanisms in our guidance for proposed PARCA identification that recognize the importance of protecting sensitive species locations from public scrutiny.

Acknowledgments: The following individuals assisted with technical review of early drafts of this report: Jeff Briggler, Bruce Bury, Robert Cherry, Gary Casper, Paulette Conrad, David Cooper, Char Corkran, Mark Danaher, Jason Daniels, Ryan Elting, William Fields, Dan Fogell, Tom Giermakowski, David Golden, David Grandmaison, Jeff Hall, Audrey Hatch, Robert Hay, John Jensen, Liz Johnson, John Kleopfer, Mary Beth Kolosvary, Mike Lannoo, Ed Laurent, Jeff LeClere, Harry LeGrand, Mike Marchand, Jonathan Mays, David Mifsud, Paul Moler, Erin Muths, Holly Niederriter, Dede Olson, Charles Painter, Chris Pearl, Joe Pechmann, James Petranka, Scott Smith, Tom Tyning, and Simon Wray**.** Additionally, Priya Nanjappa was instrumental in motivating and guiding the national PARCA task team forward and in helping to provide financial assistance through a USFWS Competitive State Wildlife Grant.

Criteria Overview and Rationale:

Conservation resources are sorely limited and it is the intent of the PARCA project to focus more attention on those remaining portions of the landscape that are playing a disproportionate role in the conservation of priority amphibian and reptile faunas within each state. As such, it is important that PARCA's meet the first criterion listed below (#1) regarding potential landscape viability followed by one or more of the next five criteria relating to species rarity (#2-4), endemicity (#5), and richness (#6). This suite of criteria is designed to ensure that PARCA's represent exceptionally important state targets for amphibian and reptile conservation - places with significant populations of rare, diverse, and unique species embedded in relatively intact (or restorable) landscapes.

We feel it is important to include a landscape viability criterion, requiring that a site be capable of supporting high value populations over time. If habitat restoration or conservation management interventions can **realistically** rescue an otherwise non-viable population of a priority species, then such sites can also be included as PARCA's, assuming the areas are deemed significant enough at the state level to qualify using the other species-based criteria.

The species rarity criteria (#2-4) are set at three priority levels (globally/nationally imperiled, state imperiled, and state vulnerable/special concern). Note that we have structured the system so that as the implied level of species rarity or conservation significance decreases, the

requirements for meeting the criteria become increasingly stringent. Due to these requirements for relative population size/importance, **not every candidate rare species will have sites that qualify for PARCA status in a particular state.** For example, it may be impossible to determine the 1-3 most important sites for a widely-distributed "species of greatest conservation need" (SGCN), and therefore none of the sites containing this species would qualify for PARCA status based on Criterion #4 alone.

Also note that a target species will often meet more than one criterion in a given state (e.g. imperiled at both the state and global levels). Furthermore, within or across regions, the same species may qualify for different levels of rarity criteria in different states. The rare species and species diversity criteria were designed such that the most important areas **within each state** will be identified. This design ensures that each state has the potential to develop a set of PARCA's, even though states differ in the global and national significance of their herpetofauna and the amount and quality of remaining natural habitat.

The species richness/diversity criterion (#6) is intended to capture areas that perhaps lack the rare, threatened, or unique species characteristics needed to meet criteria 2-5, but nevertheless host an exceptionally intact fauna representative of a particular ecoregion. In many cases, the most diverse sites within a state will also include one or more rare or threatened species. Furthermore, these locales will by definition capture populations of widespread, generalist species. Protecting such areas is an important component of PARC's mission to "keep common species common." Note that species richness is evaluated relative to the overall list of potential species associated with the ecoregion where the area is located and not based on statewide or organizational region (e.g. Northeast PARC).

Finally, a few words about Priority Amphibian and Reptile Conservation Area scale are merited; detailed guidance for drawing boundaries of a given site are included separately below. It is anticipated that the proposed size of PARCA's will vary greatly within and across PARC regions, due to differences in landscape biogeography and target species needs. It is recommended that PARCA focus areas be large enough to contain viable populations of priority species but small enough to represent realistic targets for landscape conservation. When possible boundaries should be trimmed to the minimum size required to achieve long-term conservation success, or to a scale where limited resources can be marshaled to make tangible progress toward land conservation and restoration over the next 30 years. This approach will likely fall at an intermediate landscape scale – generally above that of individual parcels and below that of entire counties or biophysical regions.

Proposed Criteria System for Designating Priority Amphibian and Reptile Conservation Areas (PARCAS)

Potential PARCA's should meet the first criterion:

1. Landscape Viability:
    i. The landscape included within the site boundaries is deemed (either by expert opinion or by population viability analysis) to be **currently** in a condition capable of supporting robust and/or viable populations of the target species; **OR**

    ii. Current landscape threats that jeopardize the viability of populations of the target species are deemed by expert opinion to be resolvable with

realistic levels of conservation intervention – e.g., habitat restoration or improved management.

Potential PARCA's should also meet one or more of the following five criteria:

2. Presence of Globally or Nationally Imperiled Species:
   i. Area currently contains one or more species (or subspecies) listed as either: a) Endangered or Threatened or Candidate under the US Endangered Species Act; b) Critically Endangered or Endangered under the IUCN red list; or c) globally Critically Imperiled (G1), Imperiled (G2) or Vulnerable (G3) under the ranking system employed by NatureServe; **AND**

   ii. Area hosts at least one modern confirmable occurrence record for the rare species in question, with modern defined as "less than 30 years old"; **AND**

   iii. Area hosts (or is believed to host, according to the best available data and expert opinion) a moderately significant population of the rare species in question. A moderately significant population is defined as representing either a) >10% of the total state population of this species; b) >10% of the total predicted geographic range of the species in the state; or c) one of the 10 most important sites for conservation of the species in the state.

   iv. *Northeast species examples:* Northern Red-bellied Turtle, Bog Turtle, Eastern Massasauga, Green Salamander, Hellbender.

   v. *Southeast species examples:* Eastern Indigo Snake, Louisiana Pine Snake, various spp. of Gopher Frog, Gopher Tortoise, nesting sea turtles.

   vi. *Southwest species examples*: Sand Dune Lizard, Mexican Garter Snake, Chiricahua Leopard Frog, Jemez Mountain Salamander.

   vii. *Midwest species examples*: Copper-bellied Watersnake, Lake Erie Watersnake

3. Presence of State Imperiled Species:
   i. Area currently contains one or more species (or subspecies) listed as either a) State Endangered or State Threatened by the state in question; or b) state Critically Imperiled (S1) or state Imperiled (S2) under the ranking system employed by NatureServe; **AND**

   ii. Area hosts multiple, modern occurrence records for the rare species in question, with modern defined as "less than 30 years old"; **AND**

   iii. Area hosts (or is believed to host, according to the best available data and expert opinion) a highly significant population of the rare species in question. A highly significant population is defined as representing either a) >20% of the total state population of this species; or b) >20% of the total predicted geographic range of the species in the state; or c) one of the 5 most important sites for conservation of the species in the state.

iv. *Northeast species examples:* Blanding's Turtle, Spotted Turtle, Diamond-backed Terrapin, Timber Rattlesnake, E. Wormsnake, E. Ratsnake, Copperhead, Five-lined Skink, E. Spadefoot Toad, Marbled Salamander

v. *Southeast species examples:* Bog Turtle, E. Diamondback Rattlesnake, Timber Rattlesnake, Carolina Pygmy Rattlesnake, Southern Hognose Snake, Mimic Glass Lizard, Weller's Salamander

vi. *Southwest Species examples*: Gila Monster, Bunch Grass Lizard, Narrowhead Garter Snake, New Mexico Ridgenose Rattlesnake, Lowland Leopard Frog, Sacramento Mountain Salamander.

vii. *Midwest species examples*: Mississippi Green Watersnake, Green Salamander, Eastern Hellbender, Blanding's Turtle, Wood Turtle

4. Presence of State Vulnerable/At-risk Species:

i. Area currently contains one or more species (or subspecies) listed as either: a) Special Concern, Vulnerable (or the equivalent) by the state in question; or b) a Species of Greatest Conservation Need (SGCN) in the state's Wildlife Action Plan; or c) State Vulnerable (S3) under the ranking system employed by NatureServe; **AND**

ii. Area hosts multiple, recent occurrence records for the vulnerable species in question, with "recent" defined as "less than 20 years old"; **AND**

iii. Area hosts (according to the best available data and expert opinion) an extremely significant population of the rare species in question. An "extremely significant population" is defined as representing either a) >30% of the total state population of this species; or b) >30% of the total predicted geographic range of the species in the state; or c) one of the 3 most important sites for conservation of the species in the state.

iv. *Northeast species examples:* Wood Turtle, Eastern Box Turtle, Eastern Ribbon Snake, Four-toed Salamander, Jefferson Salamander, Blue-spotted Salamander, Northern Spring Salamander.

v. *Southeast species examples:* Pine Barrens Treefrog, Ornate Chorus Frog, Tiger Salamander, Dwarf Waterdog, Four-toed Salamander, Scarlet Kingsnake.

vi. *Southwest Species examples*: Mountain Skink, California Kingsnake, Mottled Rock Rattlesnake, Southwestern Toad, E. Barking Frog.

vii. *Midwest species examples*: Red-Spotted Toad, Milksnake, Glossy Snake, Greater Short Horned Lizard.

5. Presence of narrowly distributed species, subspecies, phylogenetically-distinct populations, or species of high regional responsibility:

i. Area contains one or more species, subspecies, or phylogenetically-distinct populations that are either endemic to the state in question, or

otherwise geographically limited in terms of their distribution, with "geographically limited" defined as either a) occurring primarily within the state in question, or b) within a total area that is less than the average size of individual states within the region; "Phylogenetically distinct" shall be defined as significantly distinguished by genotype or morphology from similar taxa at the same level of classification; **OR**

ii. Area contains two or more target species or subspecies whose global range fall disproportionately (>50%) in a single PARC region (high regional responsibility[1]); **AND**

iii. Area hosts multiple, recent occurrence records for the narrowly-distributed taxon in question, with "recent" defined as "less than 20 years old"; **AND**

iv. Area hosts (or is believed to host, according to best available data and expert opinion) an extremely significant component of the narrowly-distributed taxon in question. An "extremely significant component" is defined as representing either a) >30% of the total state population of the taxon; or b) >30% of the total predicted geographic range of the taxon in the state; or c) one of the 3 most important sites for conservation of the taxon in the state.

v. *Northeast species examples:* New Jersey Chorus Frog, Northern Red Salamander, Long-tailed Salamander, Jefferson Salamander, Wehrle's Salamander, Cheat Mountain Salamander, Peaks of Otter Salamander, Shenandoah Salamander, Bog Turtle, Northern Redbelly Cooter, Wood Turtle, Northern Diamond-backed Terrapin, Northern Black Racer, Northern Coal Skink.

vi. *Southeast species examples:* Outer Banks Kingsnake, Wood Frogs at the NC coast, Northern Pine Snakes in the NC mountains, numerous plethodontid salamander species in the Appalachians, Neuse River Water Dog, various river turtles.

vii. *Midwest species examples*: Northern Riverine Salamander, Illinois Chorus Frog, Ozark Hellbender, Many-Ribbed Salamander.

6. Presence of an Exceptionally High Diversity of Amphibian or Reptile Species:

i. Area currently contains an exceptionally rich assemblage of amphibian and reptile populations, defined as **EITHER:** a) containing >75% of the total **native** amphibian and reptile fauna expected to occur at the site, based on published records and species lists generated for the site's ecoregion (as defined by Bailey's Ecoregions of the United States [USFS]); **OR** b) containing >90% of the total **native** species of either class of herpetofauna (amphibians or reptiles) expected to occur at the site, based on published records and species lists generated for the

[1] For Northeast PARC region see: *NEPARC 2010 Northeast Amphibian and Reptile Species of Regional Responsibility and Conservation Concern. Northeast Partners in Amphibian and Reptile Conservation (NEPARC). Publication 2010-1.*

site's ecoregion (as defined by Bailey's Ecoregions of the United States [USFS]); **AND**

ii. Area represents one of the 3 most species-rich sites for reptiles or amphibians (or amphibians and reptiles) in the ecoregion; **AND**

iii. Area hosts at least one recent occurrence record for each of the species in question, with "recent" defined as "less than 20 years old"

Guidelines for PARCA Implementation

The PARCA criteria listed above should be sufficient to identify in general terms the most important sites for amphibian and reptile conservation in each state. However, in many cases the PARCA task teams will need to use a considerable amount of care and professional judgment when drawing the exact boundaries of sites that apparently qualify for Priority Amphibian and Reptile Conservation Area status. The first section below (**Role of Regional PARC Chapters**) clarifies the role of the regional PARC chapters in supervising and facilitating the state-level PARCA designation process. The second section (**Drawing PARCA Boundaries**) provides what we feel are a set of reasonable guidelines for delineating PARCA site boundaries in the face of considerable ecological complexity, and doing so across states with a wide range of human impacts and conservation concerns. These guidelines may also be modified by the PARCA task teams to better fit the conservation realities within their various regions. In the following section (**Plan for Implementing PARCA's**), we outline a series of steps that each regional PARC organization could follow in order to ensure rapid development of Priority Amphibian and Reptile Conservation Area programs in every state.

Note that in a few cases, certain states may have nearly completed the PARCA designation process already as a result of previous habitat modeling exercises for rare wildlife species. In such cases, the state-level PARCA task team will have a much easier job, and should focus on refining the existing set of priority areas to be sure it reflects all of the target species, subspecies, and populations identified by the Regional planning team.

Also, we recognize that the PARCA designation process would be greatly facilitated if one or more herpetologists could be assigned to coordinate the planning efforts on a full-time basis. Such professional staff time will require additional fundraising (which may be sought at the national, regional, and state levels) or substantial in-kind assistance by public agencies or private organizations.

Role of National PARCA Task Team/Steering Committee

The national PARCA Task Team will potentially provide the following project oversight and support roles:

- Periodic contact with regional task teams to provide advisory support and review expertise for complex PARCA proposals
- Assistance with potential conservation planning tools and incentives for furthering regional PARCA land conservation and outreach goals
- Distribution of an annual PARCA E-Newsletter highlighting project successes, challenges, and progress nationally
- Solicitation of regional proposals for nationally-significant PARCA's
- Coordination with similar efforts in other nations (such as CARCNET's IMPARA system in Canada)

Role of Regional PARC Chapters
While the system is designed for state-level nominations and site selection, regional PARC chapters will play an important oversight and coordinating role by assuming the following responsibilities:

1. Each PARC region will designate a PARCA task team whose members will be charged with implementing the PARCA selection process across all states in the region. The regional PARCA task teams will ensure that all state PARCA plans are completed in a timely and consistent fashion, by either a) delegating the state PARCA system planning to a smaller group of state-specific experts, and monitoring the progress of the state-level team; or b) accepting responsibility at the regional level for running the PARCA site selection process for particular states with insufficient herpetological expertise or planning capacity/personnel time.

2. The Regional PARCA task teams may modify the proposed national criteria as appropriate to match the biological and geographic realities of their specific region. While it is our intent that the conceptual basis for the finalized national model criteria be maintained intact (i.e., after incorporation of reviewer comments), we recognize that the numerical thresholds proposed within each criteria may not be appropriate for every region and thus are offered as guidelines only. For example, for the globally rare species criteria (#2), regions may want to be more or less inclusive than our suggestion that qualifying sites should be "clearly one of the 10 most important sites for conservation of the species in the state." Similarly, for the diversity criteria (#6), some regional PARCA task teams may decide that the percentage of potential maximum species richness that best qualifies a site as containing an "exceptionally rich diversity of amphibians and reptiles" is more or less than 75% as proposed.

3. After the official designation of all of the state-level PARCA's in their zone, the Regional PARCA task teams will re-convene to decide which of the state PARCA's are significant enough to justify their selection as Regional PARCA's. We anticipate an order of magnitude (or more) reduction in the number of sites when moving to the Regional level. While the state-level PARCA system is designed to yield Priority Amphibian and Reptile Conservation Areas from each state, the Regional PARCA designations should focus primarily on the relative importance of the different sites at this larger scale, with less attention being paid to measures of geographic or political representation. If desired by the National PARC steering committee, an even smaller subset of the Regional PARCA's can subsequently be chosen as National PARCA's by a review panel appointed for this purpose. To facilitate such higher-level PARCA classifications, it will be essential for the various state PARCA plans to report easily comparable data on the significance and characteristics (e.g. species lists, acreage, major habitat types, threats, etc.) of each of the sites within their borders.

Plan for Implementing Priority Amphibian and Reptile Conservation Areas at the State Level:

1. Once the rare species lists and site selection criteria have been developed, the appropriate task team (regional or state) should convene a meeting of expert herpetologists familiar with the conservation status and distributional patterns of amphibians and reptiles in the target state.

Ideally, a draft list of "Priority Amphibian and Reptile Conservation Areas" for the target state will be developed at this first meeting. It will therefore be essential for participants to come prepared with as much relevant data as possible concerning target species and potential sites. The PARCA task team may in fact need to delegate to relevant experts the responsibility to identify preliminary lists of key sites for particular rare herp species prior to the first statewide meeting, using a combination of official occurrence records, field notes, expert opinion, and habitat models where available. It will also be extremely useful to bring to the meeting copies of any prior state- or ecoregion-wide conservation planning documents and associated maps of portfolio sites. This will ensure that previous large-scale prioritization efforts with relevance to amphibians and reptiles will be taken into account during the PARCA selection process. It is likely that all of these preparation efforts will rely heavily on GIS technology to integrate multiple sources of locality and habitat/land use conditions. For each candidate site, the following pieces of information will be collated at (or before) the meeting and entered into a searchable database:

a. The name and location of the site.
b. The approximate size of the site in acres.
c. The major natural habitat type(s) present at the site, and the ecoregion the site falls within.
d. The "Priority Amphibian and Reptile Conservation Areas" criteria (one or more) met by the site, and the evidence supporting each criterion, such as species lists and dates of last observation.
e. The approximate fraction of the site that is already protected in some fashion (public ownership, easement, private land trusts, etc).
f. The major threats facing amphibian and reptile populations at this site, and a ranking of the overall threat to the persistence of target herps at the site (e.g. Extreme, High, Medium, Low, None).
g. An explicit evaluation of potential conservation benefits (e.g. are there realistic land conservation and management assets that can be brought to bear?) versus risks (e.g. private landowner or municipal backlash; increased collecting or persecution of target species) associated with designation of the area as a PARCA.
h. Any additional information relevant to the listing of the site as a PARCA.

2. After the initial meeting, the Regional or State Priority Amphibian and Reptile Conservation Areas task teams will work to clean up the list, track down additional occurrence records or other needed pieces of information, and digitize the site boundaries map. The task team will also make clear recommendations regarding plans for new field surveys to generate needed biogeographic information for later rounds of the designation process. The refined list will then be circulated to the committee members and the participating expert herpetologists (including any that were unable to attend the first meeting) for review, final comments, and final site selection. For PARC regions where the PARCA selection process has been delegated to state-level task teams, the Regional PARCA committee should also review the proposed list of sites to ensure accordance with their region-specific version of the PARCA criteria. The Priority Amphibian and Reptile Conservation Areas designation is meant to imply a high degree of conservation significance, and therefore it is anticipated that not all sites nominated or considered at the initial state-level meetings will be selected as PARC-endorsed PARCA’s.

3. The committee will incorporate changes or updates as necessary from these reviews, and then publish the final listing and map of the sites, providing copies to land conservation groups, state agencies, and relevant local government planning officials. A list and description of

PARCA's will also be published on each regional PARC and national PARC website. The announcement of the sites should be made with as much public fanfare and media attention as possible, in order to attract greater attention to the program and to increase the public's awareness of the need for greater habitat conservation for amphibians and reptiles. At the same time, the PARCA committees will need to be absolutely sure that both the media and the general public are clear about the fact that PARCA designation by PARC does not imply any new legal restrictions on land use by private property owners.

4. In cases where private landowners or public land managers are receptive to the designation of their properties as PARCA's, the state, regional, and national task teams should prepare a recognition package, including colorful signage that may be displayed at the entrance to the properties, and plaques and certificates that may be displayed indoors as well. The state task teams should also provide all interested land owners and managers included within PARCA boundaries with copies of the appropriate PARC guide to habitat management for amphibians and reptiles, and arrange in-person meetings to discuss best management practices for the target species at each site.

5. If the various PARCA task teams so desire, sites (or parts of sites) within the overall "Priority Amphibian and Reptile Conservation Areas" network may be ranked by relative threat level, in order to create a separate listing of "Herp Hotspots" for each state, region, or for the nation as a whole. "Herp Hotspots" would be high priority locations that merit urgent attention from conservationists due to their elevated likelihood of being destroyed or degraded in the near future.

6. After the public release of the sites, the "Priority Amphibian and Reptile Conservation Areas" committees will continue to work actively to promote the list to conservationists, land use planners, foundations, and private citizens. The committees will attempt to track any significant conservation activities (e.g. land purchases or improvements in management) that take place on the sites, especially those that happen at least partly as a result of their PARCA designation. Results from the program will be communicated on a regular basis to the Regional and National PARC steering committees, and to any other participating organizations (such as land trusts, state conservation agencies, and various herpetological societies).

7. After a period of 3-5 years following initial site selection, the Regional or State PARCA committee will reconvene a meeting with the relevant expert herpetologists to review the status of each site, and to consider new sites for inclusion in the program. Any sites which have been seriously degraded may be removed at this time, if deemed irretrievable by the committee and experts. The committee will continue to meet every 3-5 years to evaluate progress and challenges to the PARCA program. At any point during the review cycle, new sites may be proposed for PARCA status by concerned individuals, and, if approved by the review committee, added to the official listing as soon as time permits.

Guidelines for Drawing PARCA Boundaries:

1. Ideally, the site boundaries will reflect the actual known or expected population boundaries for the species or group of species identified by one of the PARCA criteria listed above.

2.1 Frequently, data on the actual geographic boundaries of herp populations will be lacking, in which case the site boundaries should be chosen to reflect the extent of contiguous natural habitat appropriate for the species or groups of species in question. Generally, natural

landscape features such as boundaries for watersheds, natural vegetation communities, or mountain ranges should be used whenever possible to delineate PARCA sites.

2.2 Given the negative impact posed by roads and intensive development on many herp populations, site boundaries should be chosen to minimize the number of roads and urban land uses within each site. At the same time, an attempt should be made to make the site boundaries as smooth as possible - minor roads or small pockets of urbanization can be included within the boundaries of a given site if needed to maintain a cohesive shape for the "Priority Amphibian and Reptile Conservation Area". The relative amount of allowable roads, urban development, and other non-habitat land uses within a PARCA is expected to vary with the extent of habitat loss already experienced in a given state (e.g. New Jersey's standard may be less restrictive than New Mexico's). Also, individual roads may be included within site boundaries in order to emphasize the importance of mitigating the impact of the road on the target amphibian and reptile populations.

3.1 Site boundaries should be drawn such that, if the entire site were to be managed, restored, and/or protected from further habitat degradation, the target herp population(s) will be judged by expert opinion to have an excellent chance of surviving for **at least another 100 years**. Site boundaries for PARCA's should generally be drawn to include as much additional, potentially restorable habitat around the core natural areas as needed to ensure the viability of the herp population if the additional habitat were in fact restored. In other words, if possible draw the site boundaries so that the area qualifies under PARCA criteria #1 as described above. In cases where long-term site viability is unlikely, limited conservation resources are better directed elsewhere in the state.

3.2 Site boundaries should therefore also be chosen to include an appropriate combination of required habitat types (e.g. both wetlands and uplands for many amphibians) to support all life history stages of target herp species. In some cases, the long-term survival of sensitive herp species may depend on the integrity of large, pristine watersheds (e.g. Hellbenders in mountain streams in the Appalachians). In such cases the "Priority Amphibian and Reptile Conservation Area" boundaries should cover all or nearly all of the appropriate watershed, with the watershed stream order defined at a scale that is appropriate for the habitat requirements of the species.

4.1 Similarly, two or more patches of habitat with rare target species may be narrowly separated by gaps of unsuitable habitat or low-intensity human uses such as agriculture or forestry. "Priority Amphibian and Reptile Conservation Area" site boundaries in such situations should be drawn to include both patches and the potential corridors for animal dispersal between the main natural habitat patches, especially if it is deemed by expert opinion that the populations would otherwise be in jeopardy of extinction. In cases of broader separation of large blocks of habitat, each block may be designated as a separate PARCA, but the overall viability assessment may take into account the existence of the neighboring tracts of habitat. In such cases the boundaries should still be drawn to show the importance of the potential connectivity between the sites, by having extensions from each site "meet in the middle".

5. Site boundaries should be chosen carefully to avoid (where possible) singling out the property of any one private land owner. Drawing site boundaries to be intentionally "broad-brush" and slightly vague will help avoid the chance that particular landowners feel targeted by the selection of their properties as "Priority Amphibian and Reptile Conservation Areas". This consideration may not be feasible in areas where the average size of landholdings is quite large, and it may not be needed in cases where a major private landowner is known to be supportive of amphibian and reptile conservation.

6. In those regions fortunate enough to still contain very large contiguous acreages of natural or semi-natural habitat (e.g. National Forests or BLM lands in many states), boundaries for PARCA sites should be drawn to reflect the most important regions <u>within</u> the overall habitat matrix. This will allow for better targeting of improved habitat management and protection

efforts. In some cases it may not be possible to make this sort of distinction as to what qualifies as the best habitat within a large expanse of protected landscape, and therefore the entire management unit should be selected. For example, certain wide-ranging species (such as Indigo Snakes or Pine Snakes) may need considerable acreages to maintain robust populations. In all cases, the PARCA task team should strive to delineate each site at a scale that will be most beneficial for the conservation of the target amphibian and reptile species. The task team should also take pains to ensure that the site boundaries are drawn primarily with respect to the habitat requirements of the target species, and to avoid the temptation to use site boundaries defined primarily for other purposes (e.g. existing boundaries of existing parks). This independence will ensure that the designated sites carry greater weight with conservation planners and decision makers.

7. When the possibility exists that public designation of a PARCA site would clearly betray the localities of rare species prized by illegal or unscrupulous collectors, one of three options may be employed. First, the PARCA task team may simply forgo including such sites on the list of PARCA's that will be distributed to the public, and instead prepare a separate listing of sensitive sites that will only be shared with professional conservation agencies on a need-to-know basis. For species that are both highly endangered and under serious threat from collectors, this type of confidential listing of important sites is in many cases already well-established, and the task team can simply omit these taxa from consideration for the public PARCA system. Second, under certain circumstances a given site could be safely delineated as a PARCA without specific mention of the particular collection-sensitive species that occur there, especially if there are less-sensitive herp species present that also warrant PARCA status. The third alternative (following guideline #5 above) is to draw the boundaries for the PARCA in such a way that no real advantage is given to potential collectors. For example, at least theoretically it could be possible to identify a 100-square mile region in the Appalachian Mountains where several key bog turtle populations are known to occur, without cluing collectors in to the exact locations of specific wetlands that contain the turtles. In these cases, PARCA task teams should carefully weigh the expected benefits of public recognition (such as permanent habitat protection, improved management, and the potential of steering away new roads and urban developments) against a realistic appraisal of the additional collecting pressure that might result from PARCA designation. It is worth pointing out that in this age of internet satellite mapping services and field herping forums, keeping the locations of rare animal populations "secret" from experienced and highly motivated collectors is an increasingly challenging endeavor.

Links to websites for more information:

Partners in Amphibian and Reptile Conservation:
www.parcplace.org
Important Bird Areas:
www.audubon.org/bird/iba/index.html
http://www.birdlife.org/action/science/sites/index.html
CARCNET Important Areas for Reptiles and Amphibians:
http://www.carcnet.ca/english/important_areas/intro.html