Assessing Priority Amphibian and Reptile Conservation Areas (PARCAs) and vulnerability to climate change in the North Atlantic Landscape Conservation Cooperative

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January-March 2015 Activity Report

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.*

Occurrence data for Species Distribution Models (Figure 1a): Datasets from all states were received by late August 2014, although DE provided only amphibian data. Dr. Loftin received DE reptile data in early 2015. All available occurrence data provided by the states were compiled into a master file in January 2015. Drs. Loftin and Sutton met for several days in early February at the University of Maine to evaluate archived files (e.g., species location shapefiles and datasets, spatial data for environmental variables, model code, species-variables lists) and develop a timeline and task-sharing list for completing species distribution models. We discussed methods for evaluating point distributions and representation of species' ranges. Given the extreme clustering of the state date and absence of occurrence data across most species' ranges, we elected to supplement the state-provided data with HerpNet and BISON data, which allowed us to increase extent and abundance of location data with the goal of ultimately improving the species distribution models. Since early February, the state data have been partitioned by species and combined with species' HerpNet/BISON data, mapped by species to qualitatively assess point data distributions relative to species' ranges (downloaded from Natureserve, IUCN), and currently are being filtered (i.e., removing points within 600 m of other points) to reduce sampling bias and prepped for use in MaxEnt. We also are evaluating point distributions both visually and with spatial statistical tools (e.g., Ripley's K statistic) to ensure similar distributions between data and background points to be used in the SDMs. Although we have selected Maine and New Hampshire to run our initial PARCA delineation process, which will begin by late April 2015, and we will first model species occurring in NH and ME (23 species), we are preparing all occurrence datasets for species to be modeled (72) in the region. We will begin running and evaluating models for the remaining 29 species and combining these models with the richness metrics (see below) and Index of Ecological Integrity in early May 2015.

Environmental variables for Species Distribution Models: Drs. Loftin and Sutton reviewed the spatial data for the environmental variables to be used in the species distribution models. In consultation with Dr. deMaynadier, we revised the planned resolution of the SDMs to 300 m pixels (from 600 m pixels) to capture environmental data resolution at this finer scale. We evaluated spatial data layers for the 24 environmental variables to be used in the model, re-retrieved or revised layers as needed to improve data quality, reprojected, resampled, clipped, and converted to ascii files for use in the SDMs. Finally, we compiled lists of variables for each species No1 (variable lists include all variables except those that one expert identified as not important for the species) and No2 (variable lists include all variables except those that two experts identified as not important for the species) models to identify variables to be included in each species' SDMs. The environmental variables and variables lists are ready for use in the SDM development beginning in mid-April. We will be evaluating a spectrum of thresholds (e.g., minimum training presence; fixed cumulative 1, 5, and 10 thresholds; maximum training sensitivity plus specificity; AUC) to examine model suitability for each species, and we will provide species distribution model maps for each modeled species (Figure 1b. Eastern Box Turtle, *Terrapene carolina carolina;*

model variables include growing degree days, average annual and minimum temperatures, elevation) in the project summary report.

Species Richness: Dr. Loftin and Ellie McCarthy (UMaine undergraduate assistant) received all available common species data for use in calculation of the richness metric by late January. While digital polygon-based range maps spanning the NA-LCC region are available, we wanted to develop state-level richness maps for state-focused units (e.g., township, county, quad), assuming this finer resolution data would improve accuracy of the richness metric. We received data from 9 states (ME, VT, NH, MD, VA, MA, RI, NY, NJ), and we combined spreadsheet and geographic unit shapefiles to develop maps of reptile and amphibian richness to township (ME, VT, NH, RI, NY), quad (MD, NJ), quad block (MA), and county (VA). We were not able to get state-level common species data for CT, DE, and PA. We visually evaluated these richness maps and decided that the incomplete nature of many of the state datasets (representing uneven sampling effort across the states rather than lack of species occurrence) and inconsistent summary units (county, township, quad, quad-block) results in omission error that potentially affects the richness metric accuracy (see Figures 2, 3). We therefore decide to use species' range maps for our calculation of a richness metric. We rasterized (100 m pixels) species' range maps (100 amphibians, 61 reptiles) provided by Dr. Sutton from Natureserve, summed pixels by taxon across the region, and scaled the summed richness value by within-state, EPA-Ecoregion III ecoregions (see Figures 4, 5). We are evaluating the range-based richness maps, and will finalize these maps for use in the PARCA metric by mid-April 2015.

Our focus during April-June 2015 will be to complete the pilot model development and PARCA delineations, revise our approach for expanding to the entire region based on what we learn in applying the process in the pilot region, and shift our focus to completing Objective 4 so that we can prepare to elicit feedback from state experts in June-July 2015.

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.*

No recent activity

Objective 3*: Summarize these results with respect to species occurring on lands under current state and federal management.*

We have broken this objective into 3 steps to address 1) assignment of species into conservation tiers that are then used in our PARCA algorithm to weight suitability of landscape pixels; 2) how the proposed PARCAS capture individual species' occurrence location data; and, 3) how the proposed PARCAs are distributed relative to state and federal conservation lands.

1) Species Tier Assignments (*Table 1*): Drs. Loftin, Sutton, and deMaynadier met in February to discuss assignment of species to tiers identified in the "Model criteria and implementation guidance for a priority amphibian and reptile conservation area (PARCA) system in the USA". Species Tier assignment and weighting is part of development of the algorithm for identifying PARCAs with the species distribution models, amphibian and reptile richness, and an index of ecological integrity (representing "landscape viability"). We continued these discussions during February and March, with the current consensus assignments of species as Tier A (IUCN: CR, EN; Natureserve: G1-3, T1-3; USESA: E, T;) Tier A&B (State E, T), and Tier B (NEPARC: >50% range), with Tier A&B species assigned to Tier A if they are state-listed as T or E in more than 2 states or

assigned to Tier B if they are state T or E listed in 1 state. Our currently proposed weights for the Tiers are 1.0 for Tier A and 0.5 for Tier B. We will evaluate these weights and revise them as needed as we combine these metrics with richness metrics in our PARCA algorithm. This evaluation will be completed in the PARCA delineation process during April-June 2015.

2) Evaluation of species occurrence data and proposed PARCAs: We have begun activity on this part of Objective 3 with evaluation of spatial cluster evaluation tools. Currently we plan to apply the Getis-Ord statistic to identify PARCA clusters that may be combined into larger patches, however, we will continue to explore alternative approaches to PARCA cluster evaluation in April-May 2015, as well as address this part of Objective 3 during the regional PARCA identification and evaluation (May-July 2015).

3) Evaluation of PARCA distribution relative to state and federal conservation lands: no activity has been completed on this part of Objective 3; this will be addressed during April- August 2015 as part of the pilot and regional PARCA identification and evaluation.

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.*

No work has been completed for this objective at this time. This objective will be addressed in mid-2015 based on draft PARCAs.

Objective 5*: Incorporate climate vulnerability projections into final PARCA analysis, including a ranking of high priority current and future conservation areas.*

Work on this objective is in progress. We will apply the vulnerability framework developed by Drs. Sutton and Barrett to candidate PARCAs in summer 2015.

Dr. Sutton presented the draft vulnerability analysis framework at the University of Maine Wildlife, Fisheries, and Conservation Biology Department's weekly seminar series in February 2015.

Objective 6: *Communicate results to key state, federal, and NGO partners via publications and a Northeast regional workshop.*

No activity during this quarter on this objective. We will solicit feedback from key state, federal, and NGO partners on draft PARCAs during summer 2015. Plans for distributing the draft PARCAs and receiving feedback will be developed in late spring 2015. We will use our pilot project area (ME-NH) to develop and evaluate alternative formats for distributing PARCA maps and receiving feedback during late April 2015 so that by mid-May we can prepare the draft regional PARCAs for distribution for expert review and feedback (with the PARCA map format dependent on the reviewers' GIS experience level).

Activities Anticipated Next Quarter:

Completion of pilot area (NH-ME) PARCA delineation and development of feedback process; development of draft PARCAs for the region (including all SDMs) and compiling the models with richness in a PARCA algorithm, and incorporating the IEI metric (approach to be determined); preparation of materials to distribute to state experts for feedback on proposed PARCAs.

Expected End Date: June 30, 2016.

Figure 1a. Priority species occurrence location data to be used in species distribution models

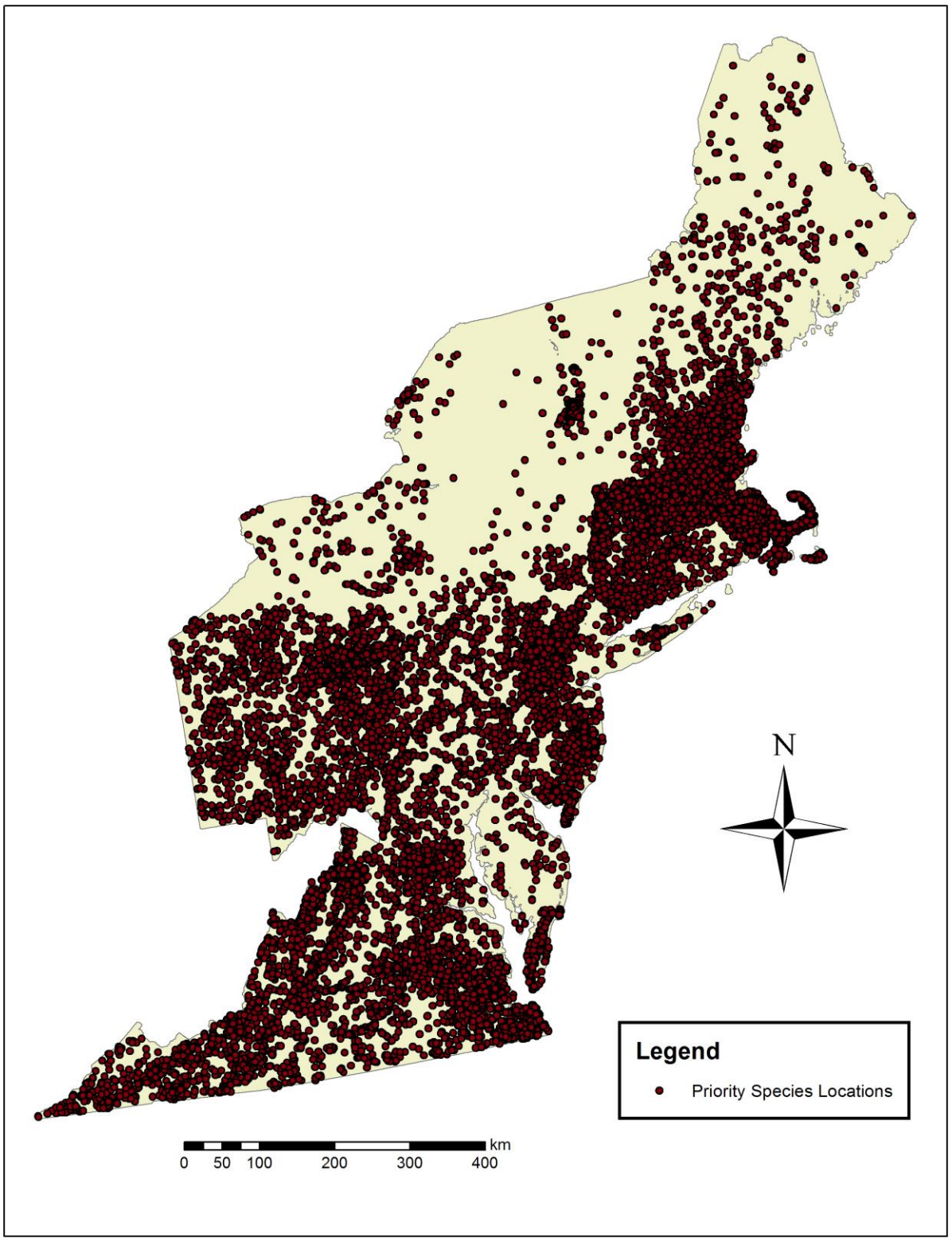


Figure 1b. Example draft species distribution model and thresholds for Eastern Box Turtle, *Terrapene carolina carolina*.

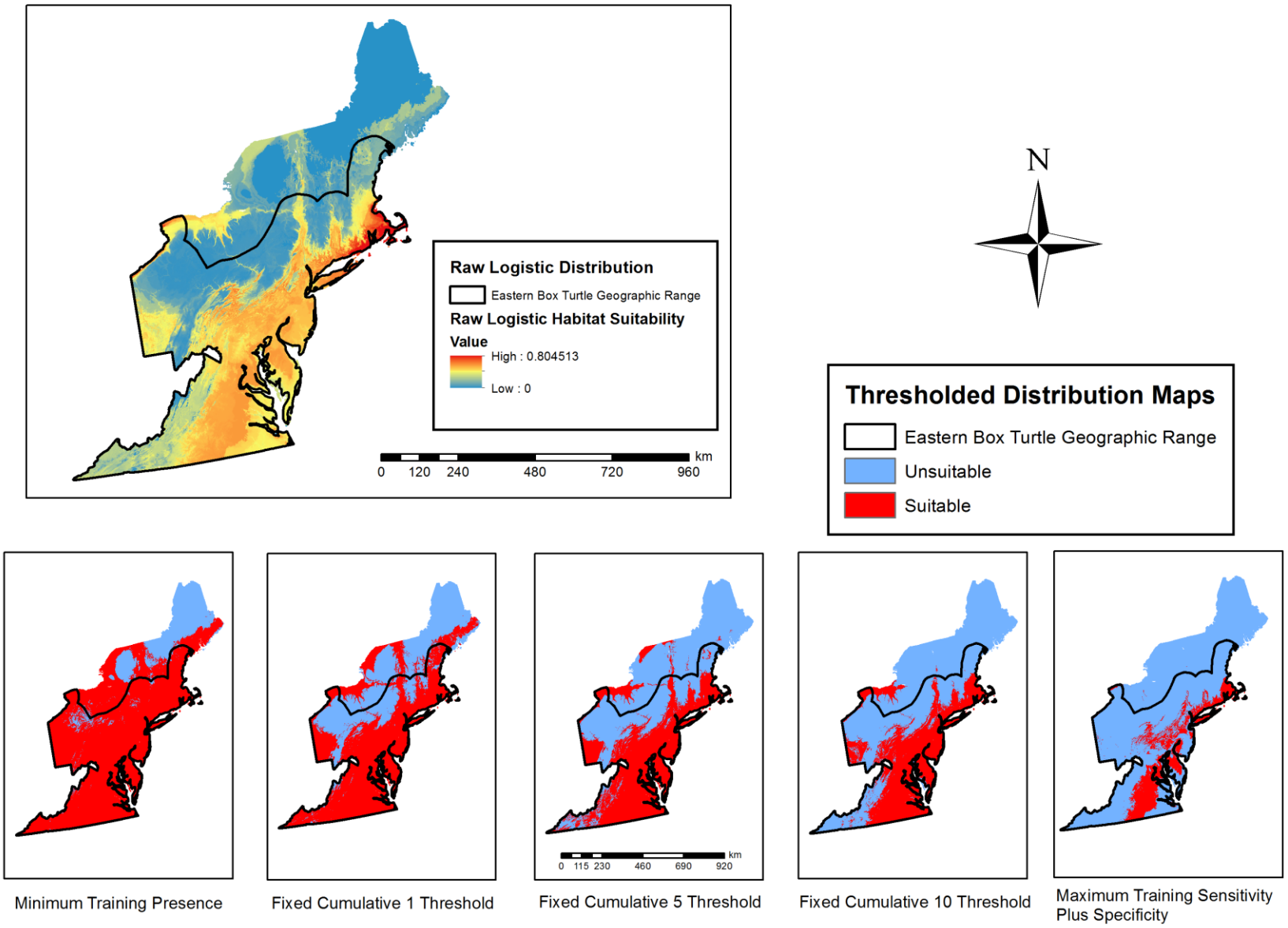
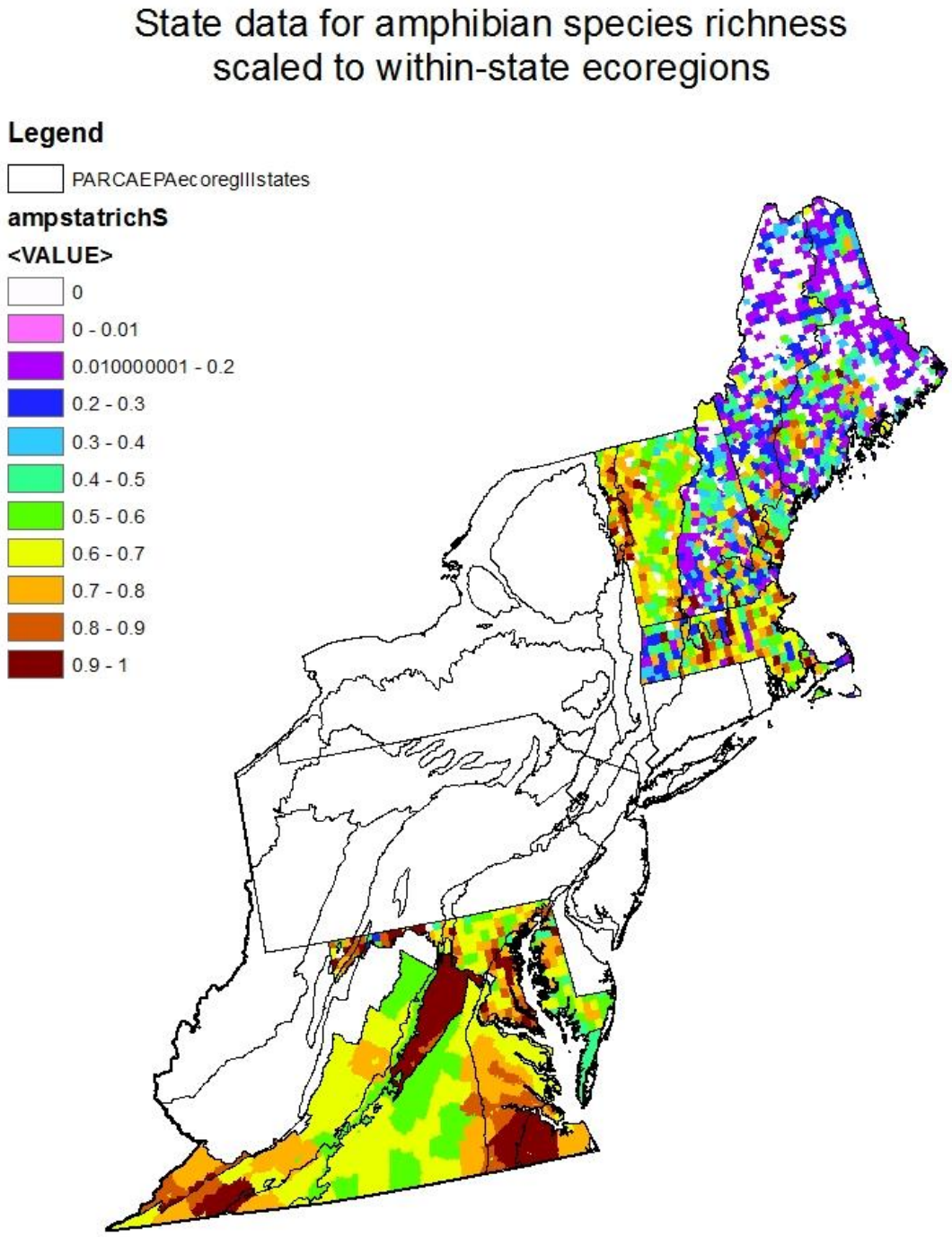


Figure 2.


State data for amphibian species richness
scaled to within-state ecoregions
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PARCAEPAecoregIIIstates
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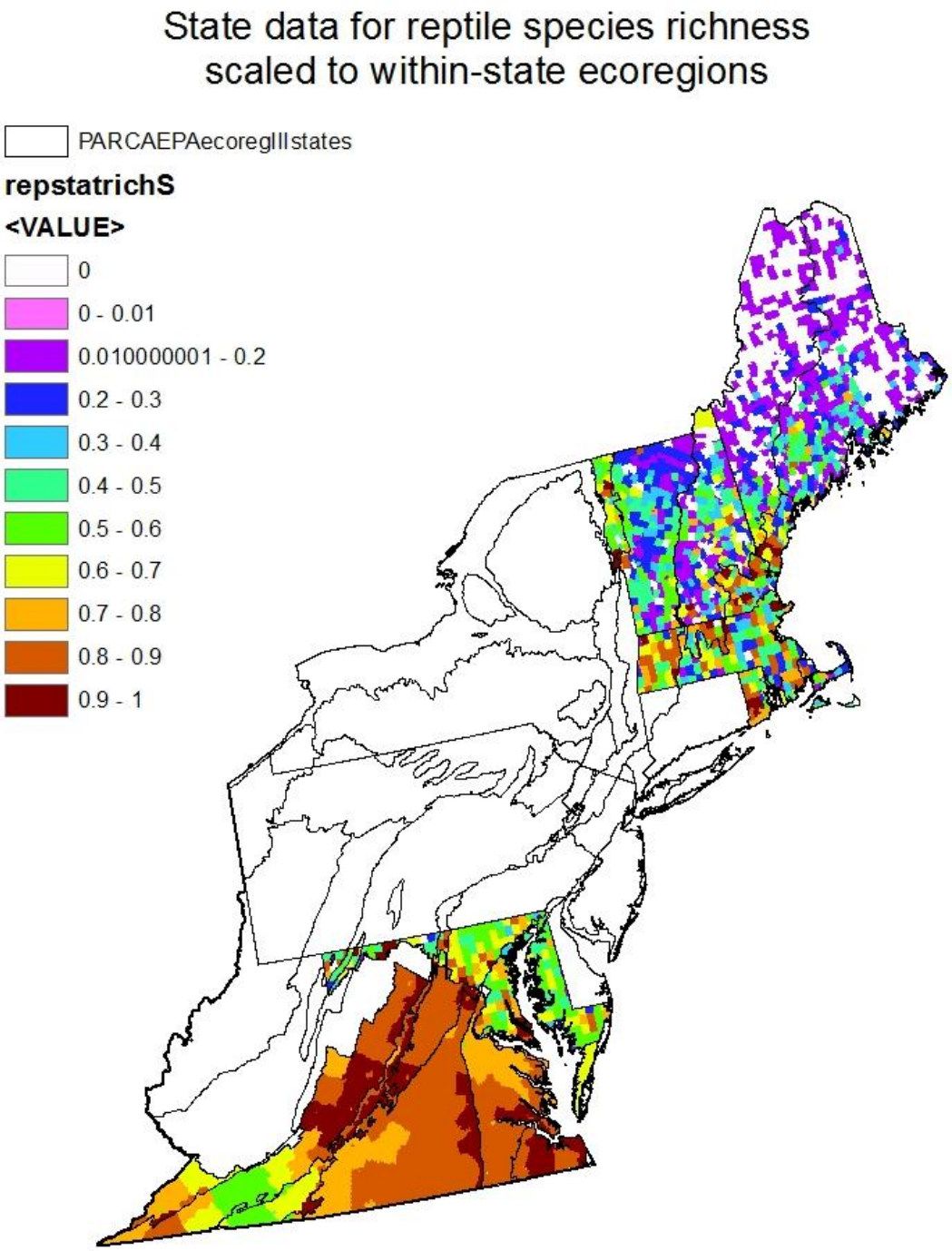
0.5 - 0.6
0.6 - 0.7
0.7 - 0.8
0.8 - 0.9
0.9 - 1

Figure 3.


State data for reptile species richness
scaled to within-state ecoregions
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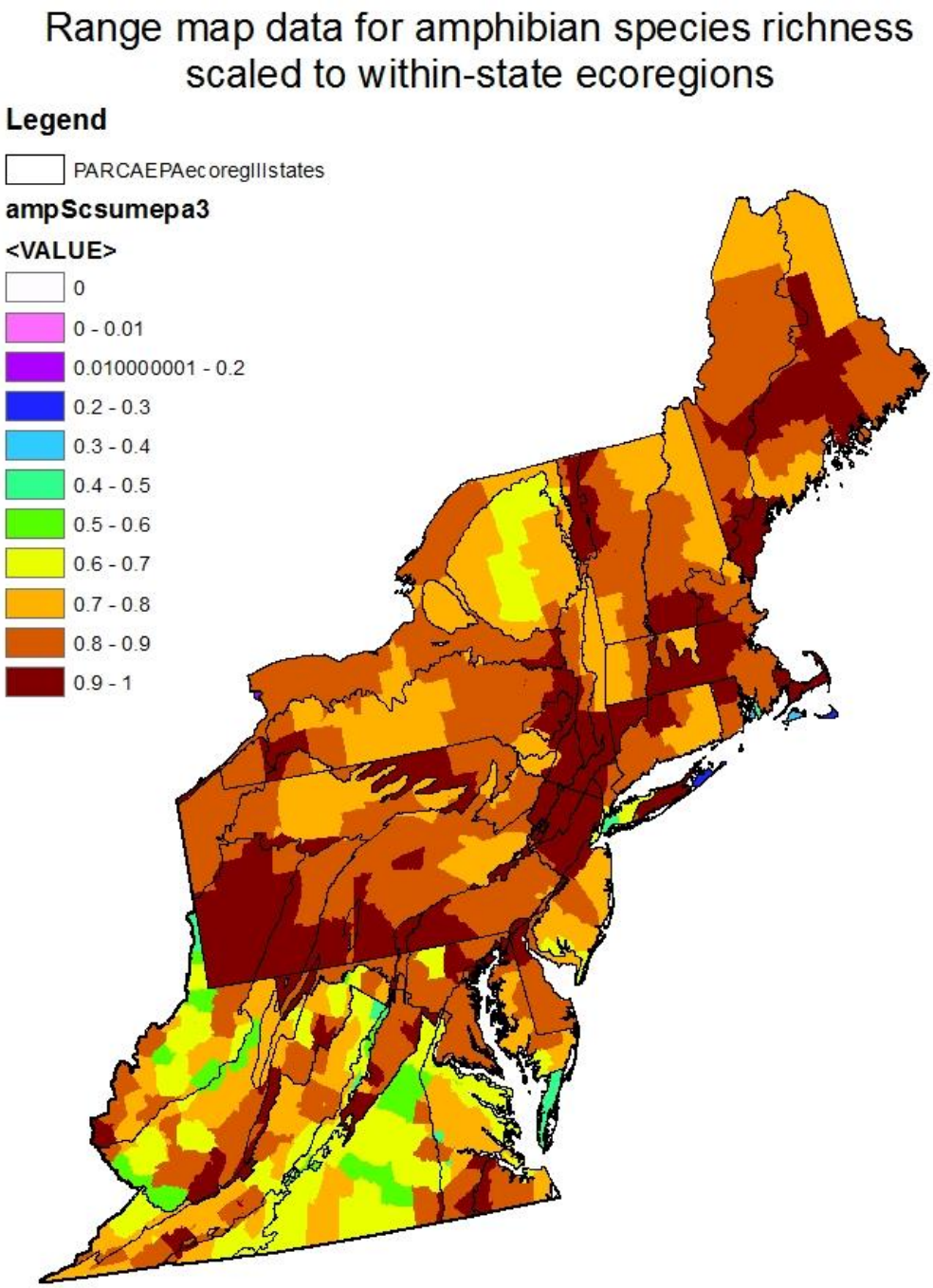
0.5 - 0.6
0.6 - 0.7
0.7 - 0.8
0.8 - 0.9
0.9 - 1

Figure 4.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0.3 - 0.4
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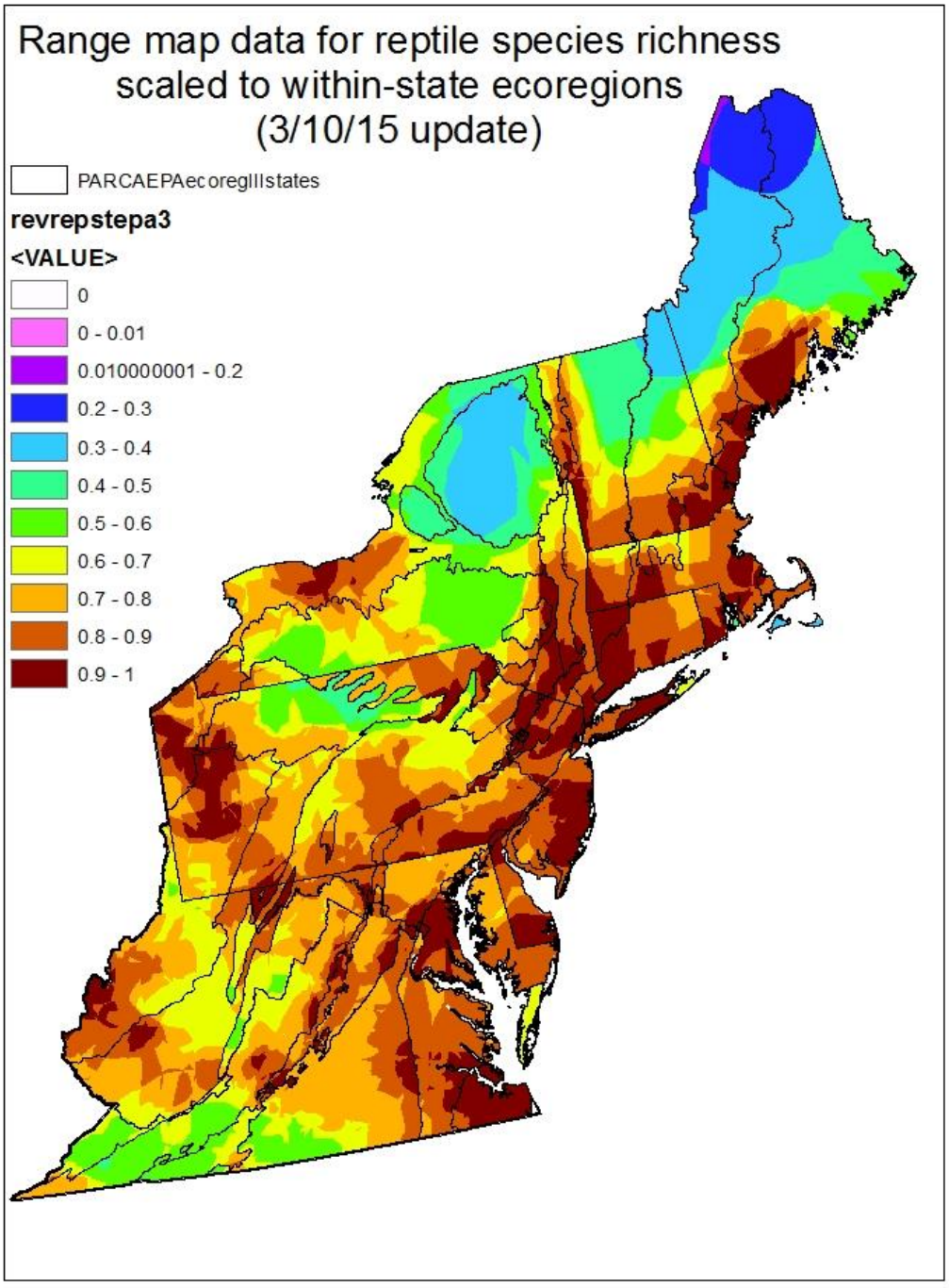
0.5 - 0.6
0.6 - 0.7
0.7 - 0.8
0.8 - 0.9
0.9 - 1

Figure 5.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scaled to within-state ecoregions
(3/10/15 update)
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0.7 - 0.8
0.8 - 0.9
0.9 - 1

Table 1. Tier assignments for compiling species distribution models into a PARCA metric

Species	Common Name	Tier
Plethodon welleri	Weller's Salamander	A
Glyptemys muhlenbergii	Bog Turtle	A
Aneides aeneus	Green Salamander	A
Plethodon shenandoah	Shenandoah Salamander	A
Pseudotriton ruber nitidus	Blue Ridge Red Salamander	A
Cryptobranchus a. alleganiensis	Eastern Hellbender	A
Desmognathus wrighti	Pygmy Salamander	A
Plethodon hubrichti	Peaks of Otter Salamander	A
Plethodon punctatus	Cow Knob Salamander	A
Plethodon virginia	Shenandoah Mountain Salamander	A
Virginia valeriae pulchra	Mountain Earthsnake	A
Emydoidea blandingii	Blanding's Turtle	A
Glyptemys insculpta	Wood Turtle	A
Clemmys guttata	Spotted Turtle	A
Pseudemys r. rubriventris	Northern Red-bellied Cooter	A
Acris crepitans	Eastern Cricket Frog	A
Hyla gratiosa	Barking Treefrog	A
Scaphiopus holbrookii	Eastern Spadefoot	A
Pseudotriton m. montanus	Eastern Mud Salamander	A
Ambystoma opacum	Marbled Salamander	A
Ambystoma tigrinum	Eastern Tiger Salamander	A
Plestiodon fasciatus	Common Five-lined Skink	A
Pantherophis alleganiensis	Eastern Ratsnake	A
Pantherophis guttatus	Red Cornsnake	A
Regina septemvittata	Queensnake	A
Agkistrodon contortrix mokasen	Copperhead	A
Crotalus horridus	Timber Rattlesnake	A
Kinosternon s. subrubrum	Eastern Mud Turtle	A
Eurycea longicauda	Long-tailed Salamander	B
Malaclemys terrapin	Diamond-backed Terrapin	B
Pseudacris kalmi	New Jersey Chorus Frog	B
Pseudotriton r. ruber	Northern Red Salamander	B
Plestiodon a. anthracinus	Northern Coal Skink	B
Coluber c. constrictor	Northern Black Racer	B
Ambystoma laterale/jeffersonianum	Blue-spotted/Jefferson Salamander	B
Lithobates sphenocephalus utricularius	Southern Leopard Frog	B
Gastrophryne carolinensis	Eastern Narrow-mouthed Toad	B
Hyla andersonii	Pine Barrens Treefrog	B
Hyla chrysoscelis	Cope's Gray Treefrog	B
Pseudacris brachyphona	Mountain Chorus Frog	B
Pseudacris maculata	Boreal Chorus Frog	B

Ambystoma mabeei	Mabee's Salamander	B
Eurycea l. longicauda	Eastern long-tailed salamander	B
Gyrinophilus p. porphyriticus	Northern Spring Salamander	B
Plethodon glutinosus	Northern Slimy Salamander	B
Ophisaurus ventralis	Eastern Glass Lizard	B
Carphophis a. amoenus	Eastern Wormsnake	B
Cemophora c. coccinea	Northern Scarletsnake	B
Farancia e. erytrogramma	Common Rainbow Snake	B
Heterodon platirhinos	Eastern Hognose Snake	B
Nerodia erythrogaster	Redbelly Watersnake	B
Opheodrys a. aestivus	Northern Rough Greensnake	B
Pituophis m. melanoleucus	Northern Pinesnake	B
Virginia valeriae pulchra	Mountain Earthsnake	B
Deirochelys r. reticularia	Eastern Chicken Turtle	B
Graptemys geographica	Northern Map Turtle	B
Apalone s. spinifera	Eastern Spiny Softshell	B
Terrapene c. carolina	Woodland Box Turtle	B
Lithobates virgatipes	Carpenter Frog	B
Lithobates pipiens	Northern Leopard Frog	B
Anaxyrus fowleri	Fowler's Toad	B
Gyrinophilus porphyriticus	Spring Salamander	B
Plethodon wehrlei	Wehrle’s Salamander	B
Desmognathus monticola	Seal Salamander	B
Desmognathus ochrophaeus	Allegheny Mountain Dusky Salamander	B
Eurycea bislineata	Northern Two-lined Salamander	B
Plethodon hoffmani	Valley and Ridge Salamander	B
Desmognathus fuscus	Northern Dusky Salamnader	B
Plestiodon laticeps	Broad-headed Skink	B
Thamnophis sauritis	Eastern Ribbonsnake	B
Opheodrys vernalis	Smooth Greensnake	B
Diadophis punctatus	Nortern Ring-necked Snake	B
Storeria dekayi	Northern Brownsnake	B
Thamnophis brachystoma	Short-headed Gartersnake	B
Chrysemys picta	Eastern Painted Turtle	B
Plethodon kentucki/cylindraceus	Cumberland Plateau/white-spotted/ slimy Salamander	B
Necturus m. maculosus	Common Mudpuppy	B

Tier Key	***Tier Justification***	***Tier***
IUCN: CR, EN	risk extinction	A
USESA: E, T	risk extinction	
Natureserve: G1-G3, T1-T3	risk extinction	
State E, T	risk extirpation	A & B
NEPARC: >50% range	regional responsibility	B