

The unexpected discovery of a new cryptic frog from the urban northeastern US

Jeremy A. Feinberg¹, Catherine E. Newman², Gregory J. Watkins-Colwell³, Matthew Schlesinger⁴, Brian Zarate⁵, H. Bradley Shaffer⁶, and Joanna Burger¹

¹ Graduate Program in Ecology and Evolution, Department of Ecology, Evolution, and Natural Resources, Rutgers University, New Brunswick, NJ, USA
² Department of Biological Sciences, Museum of Natural Science, 119 Foster Hall, Louisiana State University, Baton Rouge, LA, USA
³ Yale Peabody Museum, Yale University, New Haven, CT, USA
⁴ New York Natural Heritage Program, Albany, NY, USA
⁵ New Jersey Department of Environmental Protection, NJ, USA
⁶ Department of Ecology and Evolutionary Biology & La Kretz Center for California Conservation Science, University of California, Los Angeles, CA, USA



R. sp. nov.

R. sphenocephala

ABSTRACT

Herein, we review our pending taxonomic description of a previously undescribed leopard frog (genus *Rana* [= *Lithobates*]). This species was first detected in the New York City metro area and is similar to two regional congeners; northern and southern leopard frogs (*R. pipiens* and *R. sphenocephala*, respectively), and remained undocumented until recently despite residing in this heavily inventoried region. Elucidation of a novel, range-limited frog from one of the largest, most well-studied urban corridors on earth underscores the potential for new species in unexpected locales (including those not typically associated with concealed biodiversity or endemism) and highlights several potential conservation implications.

INTRODUCTION

The *R. pipiens* complex includes several rare or declining species and has long been a source of taxonomic uncertainty and debate (Brown et al. 1977), particularly in the northeast and New York/New Jersey metro area. In 2012, Newman et al. reported molecular evidence of a cryptic fourth “spotted” ranid among three previously recognized spotted congeners that included *R. pipiens*, *R. palustris*, and *R. sphenocephala* (the species to which the new frog was previously included).

To complete our taxonomic description, we are supplementing existing molecular data from Newman et al. (2012) with bioacoustic, morphological, and behavioral evidence to formally identify, diagnose, and separate the new species from these congeners. This information will also aid federal and state biologists in determining the conservation status of the new species.

METHODS

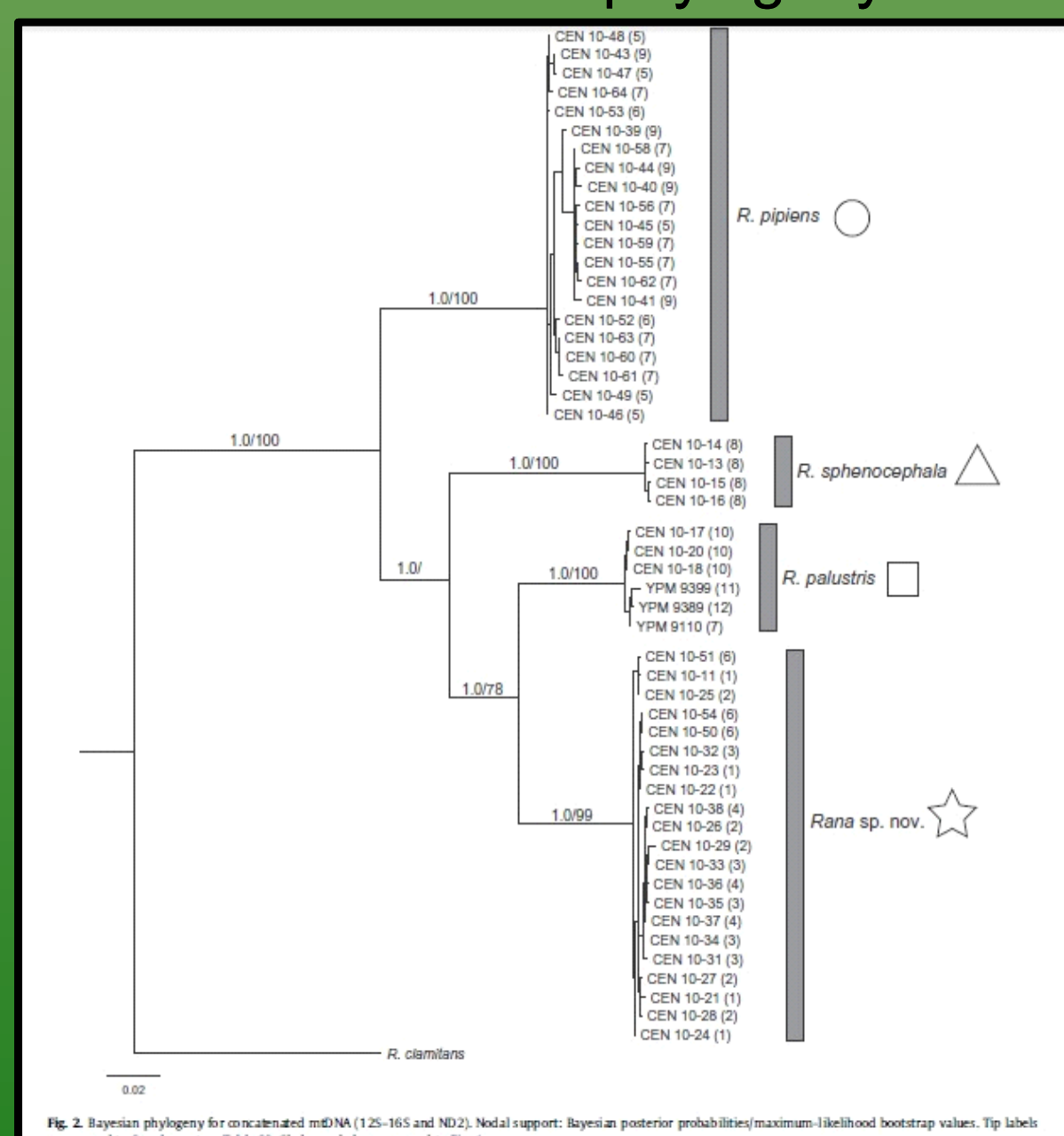
Bioacoustics:
 • Record and compare call-attribute differences between *R. sp. nov.* and similar regional congeners (including the bioacoustically similar *R. sylvatica*)

Molecular Genetics:
 • Confirm holotype nuDNA + mtDNA matches with Newman et al. (2012)

Morphology:
 • Measure museum specimens to compare standard characters
 • Screen specimens and photos for other diagnostics to separate species

Behavior:
 • Observe breeding events and determine phenological species differences

Mitochondrial phylogeny



Nuclear phylogeny

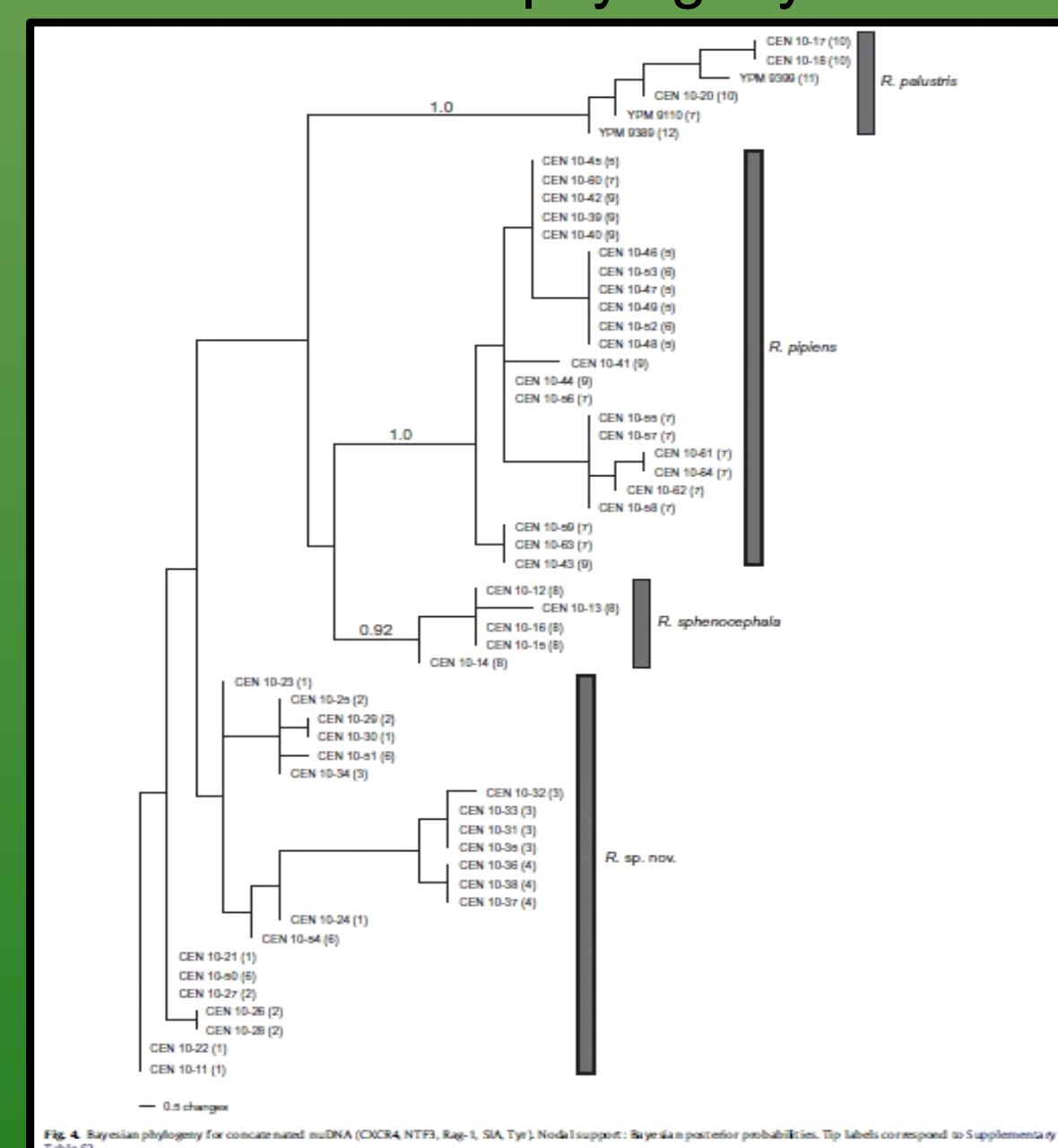


Figure 1. Phylogenies from Newman et al. (2012) comparing four *R. sp. nov.* populations in NY and NJ to three other regional congeners.

RESULTS

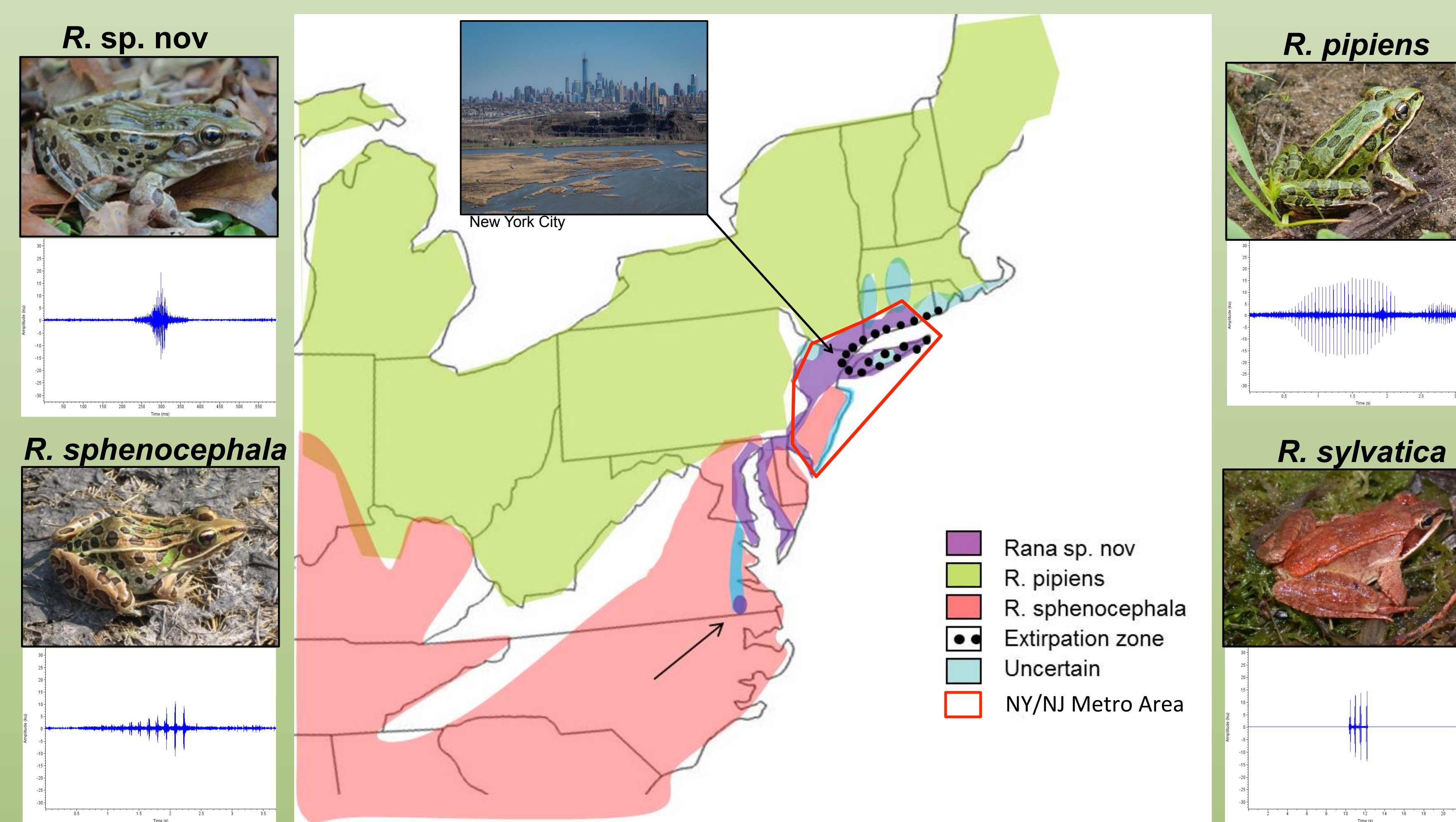
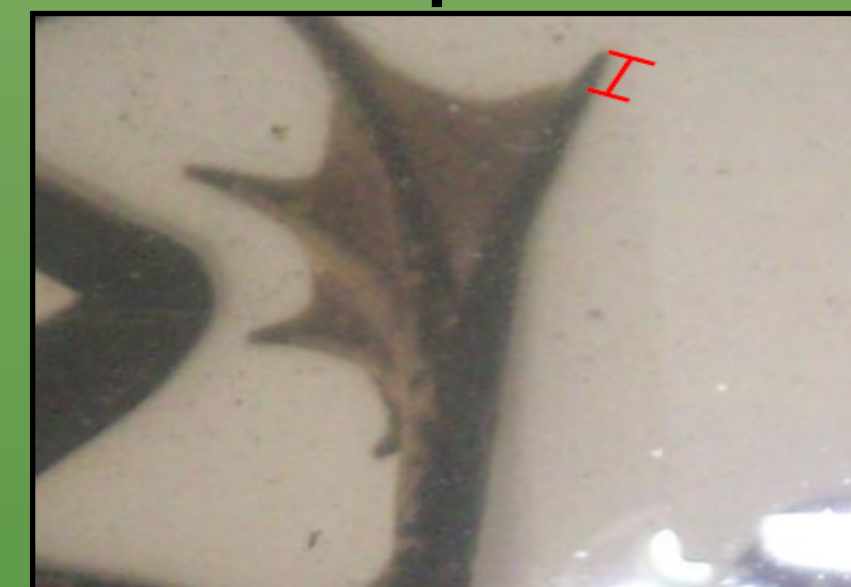


Figure 2. Range map and bioacoustic waveforms of primary calls of four regional congeners

Table 1. Summary data of detected morphological differences between *R. sp. nov.* and three regional congeners.

Character	NOV	PALU	PIPI	SPHE
N	150	33	25	35
Average of HeadWidth	18.74	17.66	19.71	18.50
Average of HeadLength	18.52	17.57	18.87	20.27
Average of TympanumDiameter	4.82	3.97	4.42	4.81
Average of Eye_Nostril_Length	3.95	4.00	4.48	4.80
Average of Interorbital_Diameter	4.16	3.66	3.63	3.72

R. sp. nov.



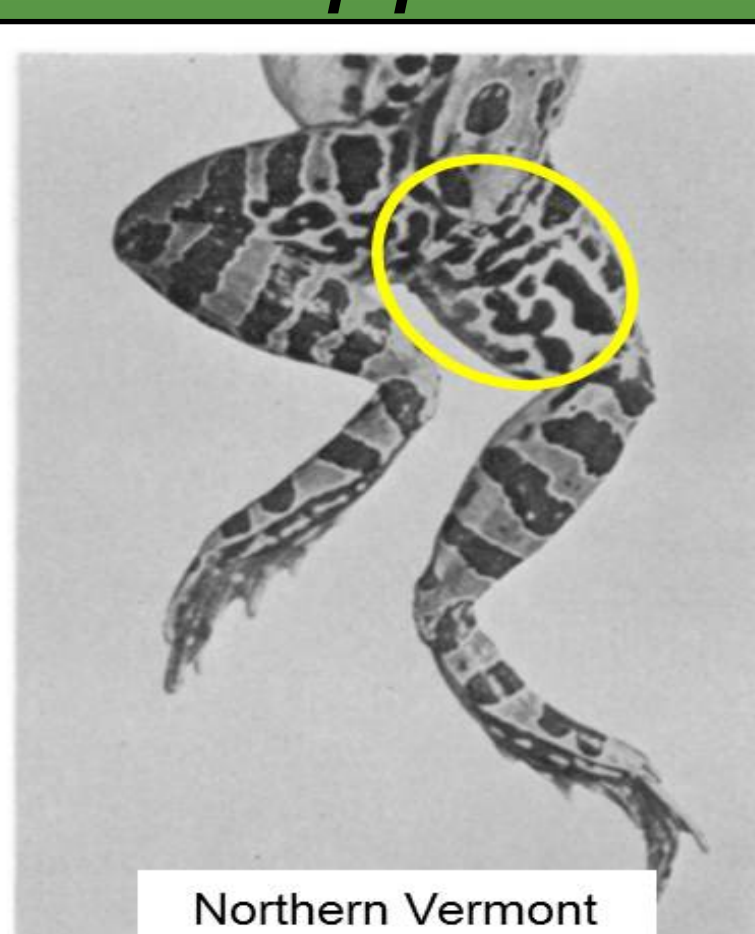
R. sphenocephala



R. sp. nov.



R. pipiens



Porter 1941. Biological Bulletin, 80(2): 238-264

Figure 3. Examples of subtle physical diagnostic differences.

CONCLUSIONS

- The new species is restricted to large, mesic, open-canopied upland/wetland “complexes” (≥ 4 ha) in coastal and riparian-floodplain habitats, largely within the narrow northeast/mid-Atlantic I-95 corridor.
- Short spring breeding season w/dense, highly-social breeding aggregations.
- Current NY/NJ metro range characterized by disjunct, isolated pops. including urban locales ≤ 5 -10 km from Manhattan and the Statue of Liberty

CONSERVATION CONSIDERATIONS

- Given range restrictions, urban geography, succeeding habitats, and disjunct, highly-social populations, this may be one of the most at-risk frog species along North American east coast.
- Major enigmatic extirpations (NY and CT) have been documented (Newman et al. 2012) and the coastal range may be threatened by rising sea levels and more frequent and powerful storms.
- At least seven states impacted by this discovery (including some w/existing leopard frog protections). Clear identification of cryptic species is essential for proper conservation and management.
- Demonstrates potential risk with presumed same-species relocations across regional landscapes. Relocations should mandate “proof of species.”

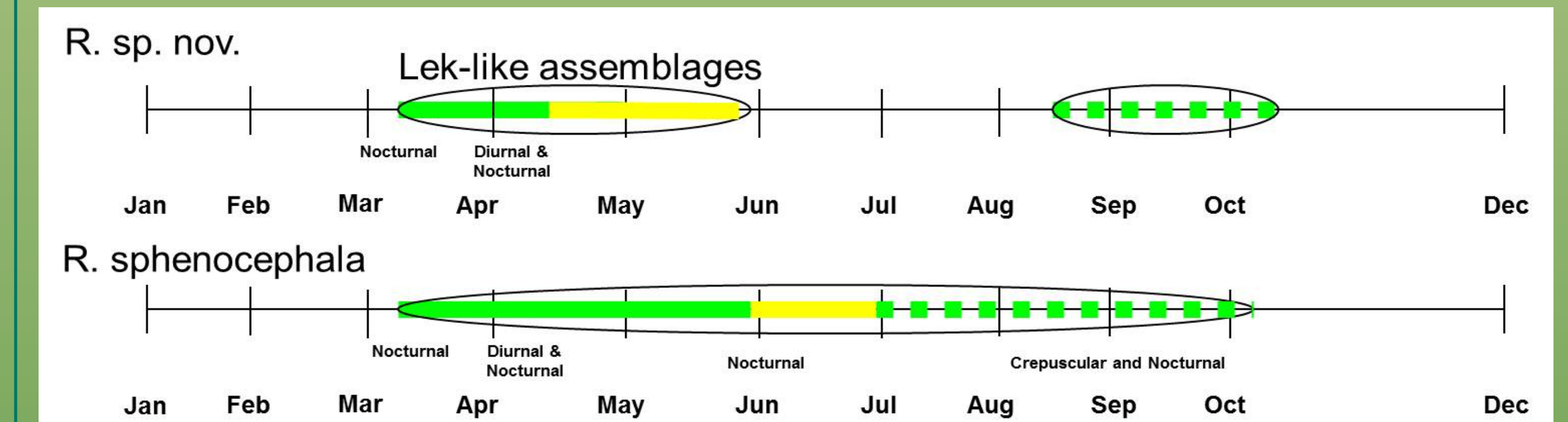


Figure 4. Phenological differences between *R. sp. nov.* and *R. sphenocephala*

LITERATURE CITED

- Brown, L.E., Smith, H.M., Funk, R.S., 1977. Request for the conservation of *Rana sphenocephala* Cope, 1886, and the suppression of *Rana utricularius* Harlan, 1826 and *Rana virescens* Cope, 1889 (Amphibia: Salientia). Bull. Zool. Nomencl. 33, 195–203.
- Newman, C.E., Feinberg, J.A., Rissler, L.J., Burger, J., Shaffer, H.B., 2012. A new species of leopard frog (Anura: Ranidae) from the urban northeastern US. Mol. Phylogenet. Evol. 63, 445-455.
- Porter, K. R., 1941. Diploid and androgenetic haploid hybridization between two forms of *Rana pipiens* Schreber. Biol. Bull. 80: 238-264.

ACKNOWLEDGEMENTS

We thank J.M. Burnley, F.C. Schlauch, E. Klaastad for critical natural history information, and Chris Jeitner and Taryn Pittfield for technical support. All research was conducted under appropriate collecting permits for New York (Collect or Possess, #969, to M.D. Schlesinger) and New Jersey (Scientific Collecting Permit to B. Zarate). Funding for fieldwork was provided by the New York State Biodiversity Research Institute, Long Island Community Foundation, Rutgers University, Brookhaven National Laboratory, and the Foundation for Ecological Research in the Northeast (to Feinberg and Burger). Funding for genetic analyses was provided by the National Science Foundation DEB-0817042 (to Shaffer, Newman, and U.C. Davis Agricultural Experiment Station).