**Fundamental niche unfilling and potential invasion risk of the slider turtle *Trachemys scripta***

Sayra Espindola, Juan L. Parra, Ella Vázquez-Domínguez

Supplemental Tables S2 – S4

**Table S1.** Literature review from where information about occurrence records, physiological optimums and tolerance limits for *Trachemys scripta* was obtained. Complete references are listed at the bottom.

|  |  |  |
| --- | --- | --- |
| **Title** | **Year** | **Ref.** |
| The growth of the Slider turtle, *Pseudemys scripta elegans.* | 1946 | 1 |
| Acute and chronic temperature effects on cardiovascular regulation in the red‑eared slider (*Trachemys scripta*). | 2015 | 2 |
| Varying Hydric Conditions during Incubation Influence Egg Water Exchange and Hatchling Phenotype in the Red‐Eared Slider Turtle.  | 2008 | 3 |
| Anoxia tolerance and freeze tolerance in hatchling turtles. | 2005 | 4 |
| *Trachemys scripta* (Slider terrapin). | 2012 | 5 |
| An experimental study of the influence of embryonic water availability, body size, and clutch on survivorship of neonatal red-eared sliders, *Trachemys scripta elegans*.  | 2002 | 6 |
| Basking Behavior of the Turtle *Pseudemys scripta*: Effects of Digestive State, Acclimation Temperature, Sex, and Season.  | 1988 | 7 |
| Dietary and Habitat Shift with Size of Red-Eared Turtles (*Pseudemys scripta*) in a Southern Louisiana Population.  | 1983 | 8 |
| Critical Thermal Maxima in Turtles. | 1966 | 9 |
| Experimental Test of the Effects of Fluctuating Incubation Temperatures on Hatchling Phenotype. | 2007 | 10 |
| Living at Extremes: Development at the Edges of Viable Temperature under Constant and Fluctuating Conditions. | 2009 | 11 |
| Acute and persistent effects of pre- and posthatching thermal environments on growth and metabolism in the red-eared slider turtle, *Trachemys scripta elegans*. | 2012 | 12 |
| Preferred body temperatures in five neartic freshwater turtles: a preliminary study. | 1993 | 13 |
| Cold Tolerance in Hatchling Slider Turtles (*Trachemys scripta*).  | 1997 | 14 |
| Temperature, phenotype, and the evolution of temperature-dependent sex determination: how do natural incubations compare to laboratory incubations?  | 2010 | 15 |
| Immigration and Dispersal of Slider Turtles *Pseudemys scripta* in Mississippi Farm Ponds.  | 1984 | 16 |
| Basking Behavior of Emydid Turtles (*Chysemys picta, Graptemys geographica*, and *Trachemys scripta*) in an Urban Landscape. | 2009 | 17 |
| Effects of body temperature on righting performance of native and invasive freshwater turtles: Consequences for competition.  | 2012 | 18 |
| Feeding status and basking requirements of freshwater turtles in an invasion context.  | 2012 | 19 |
| Translating natural history into geographic space: a macroecological perspective on the North American Slider, *Trachemys scripta* (Reptilia, Cryptodira, Emydidae). | 2009 | 20 |
| Sexual and Seasonal Differences in Behavior of *Trachemys scripta* (Testudines: Emydidae).  | 1999 | 21 |
| Response of Red-Eared Slider, *Trachemys scripta elegans*, Eggs to Slightly Differing Water Potentials.  | 1998 | 22 |
| Year-to-Year Variation in Growth in the Red-Eared Turtle, *Trachemys scripta elegans*. | 1995 | 23 |
| Natural history notes on nesting, nests, and hatchling emergence in the red-eared slider turtle, *Trachemys scripta elegans*, in west central Illinois. | 1997 | 24 |
| Annual and Local Variation in Reproduction in the Red-Eared Slider, *Trachemys scripta elegans*. | 1998 | 25 |
| Temperature-Dependent Sex Determination in the Red-Eared Slider Turtle, *Trachemys scripta*. | 1998 | 26 |
| Linking climate and physiology at the population level for a key life-history stage of turtles. | 2005 | 27 |
| Temperature, Genes, and Sex: a Comparative View of Sex Determination in *Trachemys scripta* and *Mus musculus*.  | 2005 | 28 |

1. Cagle F.R. 1946. The Growth of the Slider Turtle, *Pseudemys scripta elegans*. The American Midland Naturalist, 36, (3): 685-729.
2. Crossley II D.A., Wearng O.H., Platzacks B., Hartzler L.K., Hicks J.W. 2015. Acute and chronic temperature effects on cardiovascular regulation in the red‑eared slider (*Trachemys scripta*). J Comp Physiol B, 185:401–411.
3. Delmas V., Bonnet X., Girondot M., Pévot-Julliard A-C. 2008. Varying Hydric Conditions during Incubation Influence Egg Water Exchange and Hatchling Phenotype in the Red‐Eared Slider Turtle. Physiological and Biochemical Zoology: Ecological and Evolutionary Approaches, 81 (3): 345-355.
4. Dinkelacker S.A., Costanzo J.P., Lee Jr R.E. 2005. Anoxia tolerance and freeze tolerance in hatchling turtles. J Comp Physiol B, 175: 209-217.
5. Ficetola G.F., Rödder D. & Padoa-Schioppa E. 2012. *Trachemys scripta* (Slider terrapin). In: *Handbook of global freshwater invasive species* (ed. Francis R). Earthscan, Taylor & Francis Group Abingdon, UK, pp. 331-339.
6. Filoramo N.I., Janzen F.J. 2002. An experimental study of the influence of embryonic water availability, body size, and clutch on survivorship of neonatal red-eared sliders, *Trachemys scripta elegans*. Herpetologica, 58 (1): 67-74.
7. Hammond K.A., Spotila J.R., Standora E.A. 1988. Basking Behavior of the Turtle *Pseudemys scripta*: Effects of Digestive State, Acclimation Temperature, Sex, and Season. Physiological Zoology, 61 (1): 69-77.
8. Hart D.R. 1983. Dietary and Habitat Shift with Size of Red-Eared Turtles (*Pseudemys scripta*) in a Southern Louisiana Population. Herpetologica, 39 (3):285-290.
9. Hutchison V.H., Vinegar A., Kosh R.J. 1966. Critical Thermal Maxima in Turtles. Herpetologica, 22(1):32-41.
10. Les H.L., Paitz R.T., Bowden R.M. 2007. Experimental Test of the Effects of Fluctuating Incubation Temperatures on Hatchling Phenotype. Journal of Experimental Zoology, 307A: 274-280.
11. Les H.L., Paitz R.T., Bowden R.M. 2009. Living at Extremes: Development at the Edges of Viable Temperature under Constant and Fluctuating Conditions. Physiological and Biochemical Zoology, 82 (2): 105-112.
12. Ligon D.B., Peterson C.C., Lovern M.B. 2012. Acute and persistent effects of pre- and posthatching thermal environments on growth and metabolism in the red-eared slider turtle, *Trachemys scripta elegans*. J. Exp. Zool. 317:227–235.
13. Nutting W.L., Graham T.E. 1993. Preferred body temperatures in five neartic freshwater turtles: a preliminary study. Comp. Biochem. Physiol., 104A (2): 243-246.
14. Packard G.C., Tucker J.K. 1997. Cold Tolerance in Hatchling Slider Turtles (*Trachemys scripta*). Copeia, 1997 (2): 339-345.
15. Paitz R.T., Gould A.C., Holgersson M.C.N., Bowden R.M. 2010. Temperature, phenotype, and the evolution of temperature-dependent sex determination: how do natural incubations compare to laboratory incubations? J. Exp. Zool. (Mol. Dev. Evol.) 314B:86–93.
16. Parker W.S. 1984. Immigration and Dispersal of Slider Turtles *Pseudemys scripta* in Mississippi Farm Ponds. The American Midland Naturalist, 112(2): 280-293.
17. Peterman W.E., Ryan T.J. 2009. Basking Behavior of Emydid Turtles (*Chysemys picta, Graptemys geographica*, and *Trachemys scripta*) in an Urban Landscape. Northeastern Naturalist, 16 (4): 629-636.
18. Polo-Cavia N., López P., Martín J. 2012. Effects of body temperature on righting performance of native and invasive freshwater turtles: Consequences for competition. Physiology & Behavior, 108: 28-33.
19. Polo-Cavia N., López P., Martín J. 2012. Feeding status and basking requirements of freshwater turtles in an invasion context. Physiology & Behavior 105: 1208–1213.
20. Rodder D., Kwet A., Lotters S. 2009. Translating natural history into geographic space: a macroecological perspective on the North American Slider, *Trachemys scripta* (Reptilia, Cryptodira, Emydidae). Journal of Natural History, 43 (39-40): 2525-2536.
21. Thomas R.B., Vogrin N., Altig R. 1999. Sexual and Seasonal Differences in Behavior of *Trachemys scripta* (Testudines: Emydidae). Journal of Herpetology, 33 (3): 511-515.
22. Tucker J.K., Filoramo N.I., PAukstis G.L., Janzen F.J. 1998. Response of Red-Eared Slider, *Trachemys scripta elegans*, Eggs to Slightly Differing Water Potentials. Journal of Herpetology, 32 (1):124-128.
23. Tucker J.K., Maher R.J., Theiling C.H. 1995.Year-to-Year Variation in Growth in the Red-Eared Turtle, *Trachemys scripta elegans*. Herpetologica, 51(3):354-358.
24. Tucker, J. K. 1997. Natural history notes on nesting, nests, and hatchling emergence in the red-eared slider turtle, *Trachemys scripta elegans*, in west central Illinois. Illinois Natural History Survey Biological Notes 140. 13 pp.
25. Tucker, J.K., Paukstis G.L., Janzen F.J. 1998. Annual and Local Variation in Reproduction in the Red-Eared Slider, *Trachemys scripta elegans*. Journal of Herpetology, 32(4):515-526.
26. Wibbels T., Cowan J., LeBoeuf R. 1998. Temperature-Dependent Sex Determination in the Red-Eared Slider Turtle, *Trachemys scripta*. Journal of Experimental Zoology, 281: 409-416.
27. Willette A.S., Tucker J.K., Janzen F.J. 2005. Linking climate and physiology at the population level for a key life-history stage of turtles. Can. J. Zool., 83: 845-850.
28. Yao H. H-C., Capel B. 2005. Temperature, Genes, and Sex: a Comparative View of Sex Determination in *Trachemys scripta* and *Mus musculus*. J. Biochem., 138: 5-12.

**Table S2.** Comparison between climatic covariance matrices for *Trachemys scripta*, showing their corresponding Akaike information criterion (AIC) values. (Step-up and model building approaches).

|  |  |
| --- | --- |
| **Model** | **AIC** |
| **higher** | **lower** |
| Equality | Proportional | 6634.758 |
| Proportional | CPC | 2443.042 |
| CPC | CPC(4) | 1710.512 |
| CPC(4) | CPC(3) | 1587.103 |
| CPC(3) | CPC(2) | 1509.213 |
| CPC(2) | CPC(1) | 1205.078 |
| CPC(1) | Unrelated | 732.403 |
| Unrelated | --- | 42.000 |

**Table S3.** Contribution of the evaluated variables to the total hypervolume differences between *Trachemys scripta* native and non-native niches. The importance score reported is the ratio of the n-dimensional hypervolume relative to each of the n-1 dimensional hypervolumes, where larger values indicate that a variable contributes proportionally more to the overall volume.

|  |  |  |
| --- | --- | --- |
|  **Variable** | **Native occupied niche** | **Non-native occupied niche** |
| **bio01** | 0.9686791 | 0.9576779 |
| **bio10** | 1.1684712 | 1.1302481 |
| **bio11** | 1.0670855 | 0.992571 |
| **bio12** | 1.1333105 | 1.2999334 |
| **bio14** | 1.152466 | 1.1045099 |
| **radAnual** | 1.1497316 | 1.110255 |