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Winter Activity in a Northern Population of Mediterranean Geckos (*Hemidactylus turcicus*)

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Abstract.—**House Geckos (*Hemidactylus* spp.) have expanded their geographic ranges through human-mediated dispersal followed by establishment in anthropogenic habitats. Introduced populations of Mediterranean Geckos (*H. turcicus*) experience a wider range of climatic conditions than native populations, including locations where native reptiles undergo long periods of winter dormancy. Populations at higher latitudes are predicted to have shorter activity seasons, shorter reproductive seasons, and higher winter mortality than southern populations. Mediterranean Geckos are occasionally found inside heated buildings during winter months, however, suggesting some may avoid harsh winter temperatures using anthropogenic heat. During January to April for six years (2012–2017), freshman classes conducted nightly censuses of geckos on the outside walls of the science building at the University of Central Oklahoma (UCO), Edmond, USA. We also analyzed the UCO Natural History Museum catalog for evidence of winter activity by geckos. We observed geckos during 343 of 391 censuses (88%), including 13 of 31 censuses (42%) when ambient temperatures were 0° C or lower and 117 of 140 censuses (84%) when temperatures were between 0° C and 10.5° C (the critical thermal minimum). Museum records indicated that geckos at UCO remain active all year. These results and data from museum records suggest that Mediterranean Geckos at UCO differ from other ectotherms in the community by remaining active throughout winter. Our data suggest that Mediterranean Geckos use anthropogenic heat to support winter activity. It remains unclear how much overall activity is diminished in winter and how much activity is transferred inside buildings.**

Key Words.—anthropogenic heat; exotic species; northern range boundary; winter biology

Introduction

For centuries, house geckos (*Hemidactylus* spp.) have expanded their geographic ranges through human-mediated jump dispersal (Kluge 1969; Weterings and Vetter 2017). Introduced populations are human commensals (Hulme-Beaman et al. 2016), occupying anthropogenic habitats on all continents except Antarctica (Weterings and Vetter 2017). Mediterranean Geckos (*Hemidactylus turcicus*) were first recorded in Key West, Florida, USA, in 1910 (Fowler 1915) and have subsequently colonized much of the southern U.S. and Mexico (Rödder and Lötters 2009). North American populations of *H. turcicus* experience a wider range of climatic conditions than native populations in the Mediterranean region (Rödder and Lötters 2009). At the southern edge of the introduced range, geckos experience a relatively warm climate, are active year-round, reproduce from April-September (Selcer 1986), and reach high densities in habitats not heated in winter such as cemeteries (Rose and Barbour 1968). Despite the long activity season, southern populations of *H. turcicus* are gradually being replaced by other, more competitive *Hemidactylus* species (Meshaka et al. 2004).

The northern range boundary of introduced *H. turcicus* is expanding and expected to extend further due to climate change (Weterings and Vetter 2017). Currently, there are known breeding populations in the USA in Tennessee (Nordberg et al. 2013; Wessels et al. 2018), Arkansas (Paulissen and Buchanan 1991), Oklahoma (Locey and Stone 2006; White et al. 2016), and Pennsylvania (Ruhe et al. 2019). These northern populations experience colder conditions than other populations in the geographic range of *H. turcicus* (Wessels et al. 2018), at latitudes where native lizards undergo long periods of winter dormancy (Etheridge et al. 1983; Endriss et al. 2007; York and Baird 2017). Compared to southern populations, northern populations likely experience reduced activity seasons (Paulissen and Buchanan 1991; Wessels et al. 2018) and shorter reproductive seasons (Paulissen and Buchanan 1991), with potential consequences for fecundity, growth, and survival (Locey and Stone 2006; Meshaka et al. 2006; Wessels et al. 2018).

Understanding the winter biology of Mediterranean Geckos can be important to determining how far the species can spread. Though winter sampling has been infrequent, geckos appear to be absent from outside walls from early October to mid-April in Arkansas (Paulissen and Buchanan 1991) and from early December to mid-March in Tennessee (Wessels et al. 2018). Geckos are occasionally seen inside heated buildings during winter (Paulissen and Buchanan 1991; Locey and Stone 2006; Ruhe et al. 2019), and geckos reach highest abundance on structures that are heated in winter (Locey and Stone 2008). Taken together, these observations suggest geckos move into buildings and use anthropogenic heat to support activity in winter.

Mediterranean Geckos were introduced to the University of Central Oklahoma (UCO) campus during the 1990s (Locey and Stone 2006) and currently occur on many campus buildings (Stabler et al. 2011) and in many other locations in Oklahoma, USA (White et al. 2016). The source population for the UCO introduction was Goose Island State Park, Aransas County, Texas, USA (Locey and Stone 2006), a site with a frost-free period of 334 d/y (The Old Farmer's Almanac. 2020. First and Last Frost Dates. Yankee Publishing. Available from https://www.almanac.com/gardening/frostdates [Accessed 4 July 2020]), where geckos are likely active all year. In contrast, the UCO site has a frost-free period of 188 d/y (The Old Farmer's Almanac. 2020. *op. cit.*), with long periods where air temperatures are below the critical thermal minimum (10.5° C, Huey et al. 1989; 20° C; Litmer and Murray 2019) for Mediterranean Geckos. Here, we use winter surveys conducted by freshman biology classes at UCO and museum records from the UCO Natural History Museum (UCONHM) to quantify winter activity of Mediterranean Geckos outside a campus building at UCO.

Materials and Methods

Study area.—The study area was Howell Hall, University of Central Oklahoma, Edmond, Oklahoma, USA (35.652N, 97.477W, elevation 366 m; Locey and Stone 2006). We used the Google Earth path tool to determine the perimeter of Howell Hall to be 398 m (https://www.google.com/earth/versions/). Howell Hall was three stories for much of its footprint and surfaced primarily with brick, concrete, and stucco. There were numerous opportunities for geckos to move between the inside and outside of Howell Hall via vents and cracks in walls, and through openings around windows and doors. The lighting outside the building varied in intensity and source, and included wall mounted outside lights and interior lights that were visible through windows and glass doors. The building was encircled with low cut grass, concrete sidewalks, and mulch beds. Vegetation along the perimeter of the building was minimal and rarely exceeded 25 cm in height. For more information about gecko microhabitat, demography, and potential predators at UCO refer to Locey and Stone (2006, 2008).

Class project.—For six spring semesters (2012–2017), students in the Biology 1 for Majors (BIO 1204) section taught by PAS participated in a class project in which nightly censuses of geckos were conducted January-April on the exterior of Howell Hall. During the early part of the semester, one 50-min class period was devoted to describing the study to students. After that, students were in charge of organizing and conducting censuses, collecting and entering data, and writing a report summarizing the results. Each year the report focused on the relationship between ambient temperature and the number of geckos observed during censuses.

Censuses.—Students were instructed to slowly walk around Howell Hall using a flashlight to inspect all walls, windows, entryways, and ancillary structures (e.g., trash cans). When a gecko was observed, its approximate location was recorded on a printed map of the building derived from Google Earth Pro (https://www.google.com/earth/versions/). Each census involved a complete circuit of Howell Hall where all accessible structures were inspected once. Students were encouraged to split into two groups moving in opposite directions whenever four or more students were present at the beginning of a census. Otherwise, we did not try to control sampling effort and there was variation in census duration: (mean $\pm$ standard error, range) = 40.6 $\pm$ 16.46 min (11–110 min), number of students per census = 3.6 $\pm$ 2.21 (1–13), and census start time = 2000 $\pm$ 1.8 h (1800–0213). Generally, censuses were conducted shortly after dark, which corresponds with peak gecko activity in other populations (Rose and Barbour 1968). After a late start the first year (28 February), we began censusing each year between 25 January to 2 February and ended each year between 1 and 22 April. Censusing lasted on average 69 d (range, 55–82 d) each year. With all years combined, there were 416 potential census nights, and censuses were conducted on 391 nights (94%).

Museum specimens.—Since 1998, we have collected and deposited in UCONHM any dead geckos we encountered. Gecko specimens were either freshly dead, in which case they were injected with 10% formalin and stored in 70% ethanol, or mummified skeletons, in which case they were stored in specimen containers in a dry room. For this analysis, we included all freshly dead geckos (catalog numbers available upon request) and compared the number of specimens collected during the predicted frost-free period (17 April to 22 October, 188 d; The Old Farmer's Almanac. 2020. *op. cit.*) to the number collected during the period with frost (177 d), reasoning that freshly dead geckos collected during cold months would indicate winter activity.

Table 1. Dates and temperatures for first census, first sighting, and all periods when Mediterranean Geckos (*Hemidactylus turcicus*) were not observed for two or more censuses outside Howell Hall at the University of Central Oklahoma, Edmond, USA. The duration column is the number of consecutive censuses with no geckos observed.

	First Censuses/Sightings			Consecutive Censuses without Sightings		
Year	First Census	First Sighting	First Sighting Temp. (°C)	Start Date	Duration (censuses)	Start Date Temp. (°C)
2012	28 February	28 February	18.89	none		
2013	23 January	23 January	13.89	20 February	2	1.11
				26 February	2	0.56
2014	27 January	29 January	3.33	27 January	2	-8.33
				1 February	9	-0.56
				26 February	3	-1.67
2015	2 February	3 February	8.89	23 February	4	-7.22
2016	25 January	25 January	3.33	none		
2017	30 January	30 January	15.56	12 March	2	8.33

Data analyses.—We used the Oklahoma Mesonet (Brock et al. 1995; McPherson et al. 2007) to obtain air temperatures from the same time (2000) each night at the OKCN weather station (about 11.7 km from Howell Hall). To assess the relationship between the fixed effect of temperature and the response of number of geckos observed, we fit a negative binomial mixed-effects model using the glmmTMB function (R package glmmTMB), accounting for year as a random effect (Brooks et al. 2017; R Core Team 2020). We used the nbinom2 parameterization for the negative binomial family and allowed the dispersion parameter to vary with temperature.

Results

Censuses.—We observed geckos by the third census each year and during 343 of 391 censuses (88%; Table 1). Combining years, we observed 4,415 geckos, with an overall median geckos per census of 7, and a range of 0–82 (Fig. 1). We failed to observe geckos on consecutive days during seven periods in 6 y, including one stretch

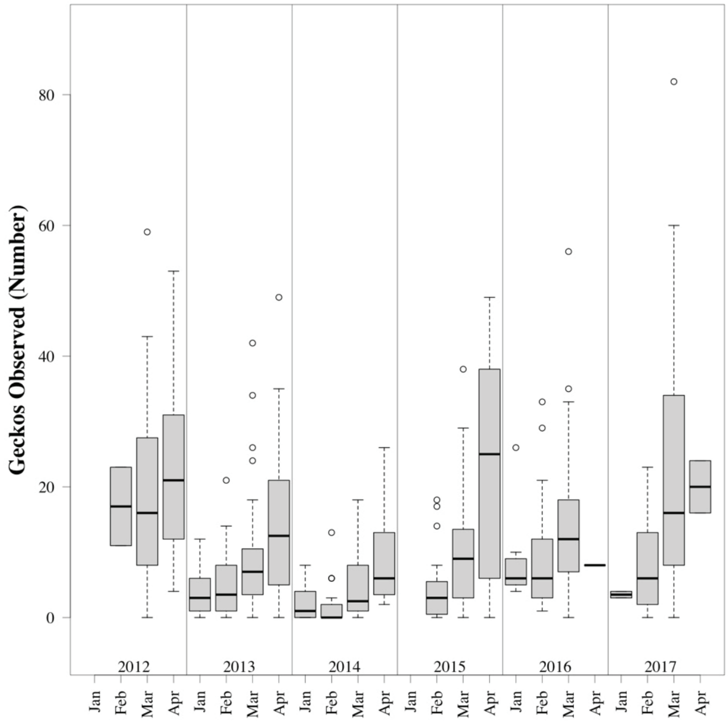

Figure 1. Box plots of Mediterranean Geckos (*Hemidactylus turcicus*) observed at Howell Hall of the University of Central Oklahoma, Edmond, USA, by month for each month of the study. Thick horizontal lines are medians, box edges are upper and lower quartiles, brackets defined by dashed lines are ranges, and open circles are outliers.

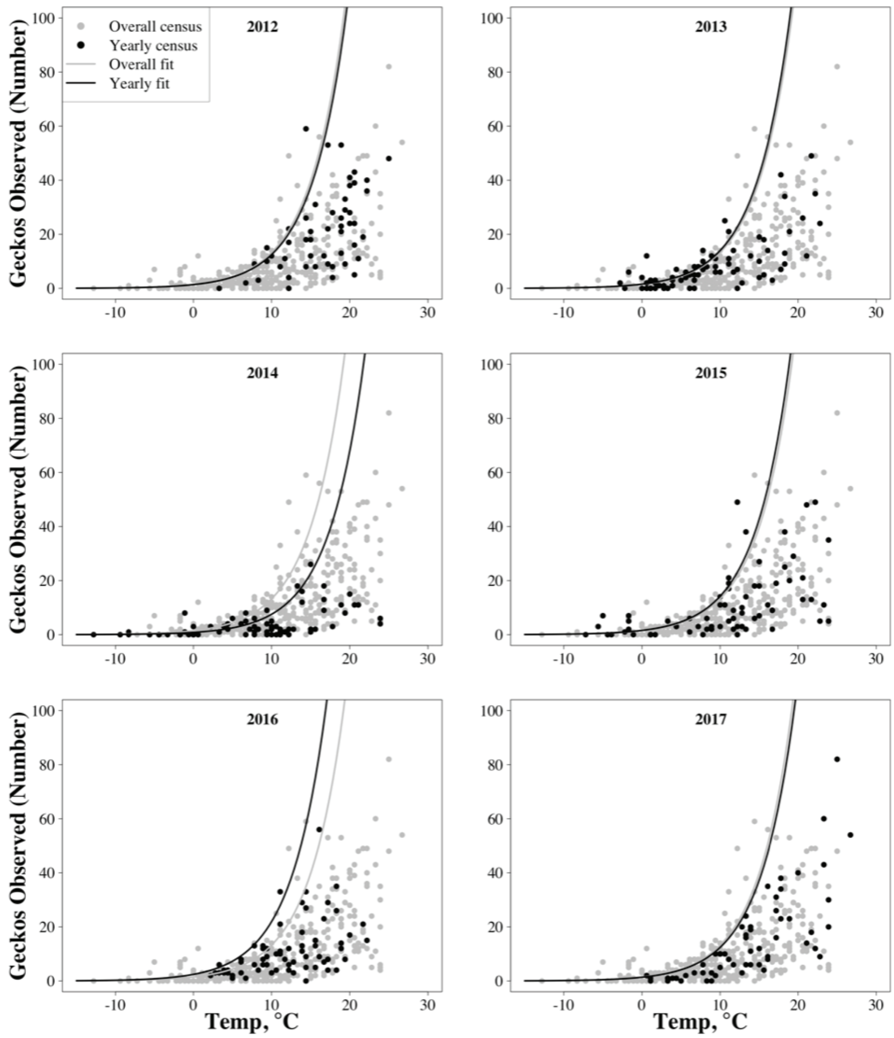

Figure 2. Relationship between air temperatures at average census start time (2000) and number of Mediterranean Geckos (*Hemidactylus turcicus*) observed at Howell Hall of the University of Central Oklahoma, Edmond, USA, during nightly censuses. On each panel, large black dots represent nightly censuses for a given year and small gray dots represent censuses from all other years. The black curve is the fit for a given year, and the gray line (identical across all panels) indicates the overall fit by the fixed effect of temperature.

of 9 d in which ambient temperature was 0° C or lower every day (Table 1). We observed geckos during 13 of 31 censuses (42%) when ambient temperatures were 0° C or lower, and during 117 of 140 censuses (84%) when temperatures were between 0° C and 10.5° C, the lowest critical thermal minimum for this species in the U.S. (Huey et al. 1989). On 3 March 2014, we observed a gecko when the air temperature was -8.3° C, and on 4 March 2015, we observed seven geckos when the air temperature was -5.0° C. Increases in both count and dispersion parameters were associated with increases in ambient temperature (Fig. 2, Table 2). Curves of gecko counts against temperature were similar in most years to the overall fit, but were higher in 2012 and lower in 2014 than predicted by the overall fit (Fig. 2).

Table 2. Results of negative binomial mixed-effects model with the number of Mediterranean Geckos (*Hemidactylus turcicus*) observed as the response variable and census year as a random effect (variance corresponding to year = 0.07413) at the University of Central Oklahoma, Edmond, USA. The abbreviation SE = standard error. Model diagnostics are AIC = 2421.5, BIC = 2441.3, log-likelihood = -1205.7, deviance = 2411.5, and residual df = 386.

	Estimate	SE	*Z*-value	*P*-value
Conditional Model				
Intercept	0.8116	0.1560	5.20	< 0.001
Temperature	0.1138	0.0073	15.59	< 0.001
Dispersion				
Intercept	-0.0034	0.2268	-0.015	0.988
Temperature	0.0512	0.0153	3.33	< 0.001

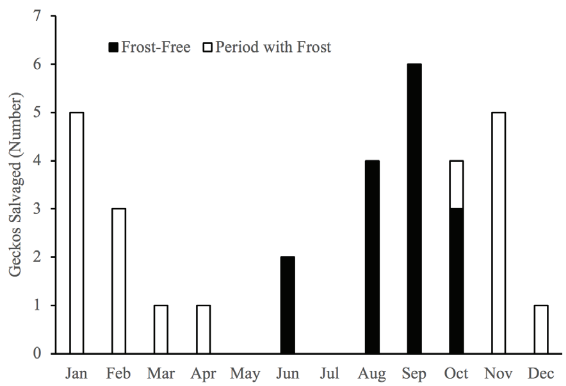

Figure 3. Mediterranean Geckos (*Hemidactylus turcicus*) deposited in UCONHM since 1996. Each specimen was freshly dead and collected from the campus of the University of Central Oklahoma, Edmond, USA.

Museum specimens.—Of 32 freshly dead geckos deposited in UCONHM since 1996, 15 were collected during the normal frost-free period, and 17 were collected during the period when frost was expected (Fig. 3). Geckos were collected in roughly equal numbers inside (n = 18) and outside (n = 14) campus buildings, irrespective of season, with nine collected inside during cold months, and nine collected inside during warm months.

Discussion

We observed Mediterranean Geckos on the walls outside Howell Hall during winter for six consecutive years, often when environmental temperatures were below freezing. We observed geckos on 88% of all censuses, including the first annual census in 4 of 6 y, and there were only seven periods in 6 y when geckos were absent from consecutive censuses (Table 1). Freshly dead geckos were also salvaged during winter months, from both inside and outside Howell Hall. These observations indicate Mediterranean Geckos at UCO are active year-round, with no population-wide dormancy for extended periods, despite the proximity to the northern range boundary of the species.

Given the inexperience of students and the lack of training and oversight, we expected observer errors in the data. In particular, it is likely that gecko activity was sometimes underestimated on cold nights when careful inspection of the entire habitat might have been challenging. The high level of enthusiasm exhibited by participants and the large number of censuses may have counteracted this problem, however. Moreover, our conclusions would be similar if presence/absence data were analyzed instead of abundance.

Even though geckos at UCO were active in winter, activity levels were reduced on cold nights, as documented in other studies (Rose and Barbour 1968; Paulissen and Buchanan 1991). The median number of geckos observed during our censuses was 7, which is about 10% of a typical mid-summer census (Locey and Stone 2008; Stabler et al. 2011; unpubl. data). Compared to geckos at UCO, geckos at the source population in south Texas experience 146 fewer days with frost each year (The Old Farmer's Almanac. 2020. *op. cit.*). Long periods of reduced activity in northern populations could decrease survival, growth, and reproduction, influencing the eventual northern range boundary of this expanding species (Meshaka et al. 2006; Locey and Stone 2006; Wessels et al. 2018).

Alternatively, geckos in northern populations could avoid long periods of suboptimal temperatures by shifting activity to the inside of heated buildings, using anthropogenic heat to support winter activity without long periods of dormancy (Nelson and Carey 1993; Jadin and Coleman 2007; Farallo et al. 2009). Our data support this hypothesis, even though activity levels inside Howell Hall are unknown. Efforts to sample geckos inside Howell Hall have been thwarted by cleaning crews and access to offices, but mostly by the many places inside the building (above floors, below ceilings, between walls) where geckos can go but humans cannot. Without data on gecko activity inside Howell Hall, it remains unclear how much overall activity is diminished in winter and how much activity is transferred inside. Museum records, however, confirm the presence of geckos inside the building during winter, and the persistent presence of geckos outside the building during winter does not seem possible without anthropogenic heat subsidies. Mediterranean Geckos are thermoconformers, with a 10.5° C to 20° C critical thermal minimum (Huey et al. 1989; Litmer and Murray 2019), and body temperatures that closely match environmental temperatures (Huey et al. 1989; Hitchcock and McBrayer 2006). Without anthropogenic heat, winter survival would likely require long periods of dormancy, as it does with every native lizard species in central Oklahoma (e.g., Etheridge et al. 1983; Endriss et al. 2007; York and Baird 2017).

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Literature Cited

Brock, F.V., K.C. Crawford, R.L. Elliott, G.W. Cuperus, S.J. Stadler, H.L. Johnson, and M.D. Eilts. 1995. The Oklahoma Mesonet: a technical overview. Journal of Atmospheric and Oceanic Technology 12:5–19.

Brooks, M.E., K. Kristensen, K.J. van Benthem, A. Magnusson, C.W. Berg, A. Nielsen, H.J. Skaug, M. Maechler, and B.M. Bolker. 2017. glmmTMB balances speed and flexibility among packages for zero-inflated generalized linear mixed modelling. R Journal 9:378–400.

Endriss, D.A., E.C. Hellgren, S.F. Fox, and R.W. Moody. 2007. Demography of an urban population of the Texas Horned Lizard (*Phrynosoma cornutum*) in central Oklahoma. Herpetologica 63:320–331.

Etheridge, K., L.C. Wit, and J.C. Sellers. 1983. Hibernation in the lizard *Cnemidophorus sexlineatus* (Lacertilia: Teiidae). Copeia 1983:206–214.

Farallo, V.R., R.L. Swanson, G.R. Hood, J.R. Troy, and M.R.J. Forstner. 2009. New county records for the Mediterranean House Gecko (*Hemidactylus turcicus*) in central Texas, with comments on human-mediated dispersal. Applied Herpetology 6:196–198.

Fowler, H.W. 1915. Cold-blooded vertebrates from Florida, the West Indies, Costa Rica, and eastern Brazil. Proceedings of the Academy of Natural Sciences of Philadelphia 67:244–269.

Hitchcock, M.A., and L.D. McBrayer. 2006. Thermoregulation in nocturnal ectotherms: seasonal and intraspecific variation in the Mediterranean Gecko (*Hemidactylus turcicus*). Journal of Herpetology 40:185–195.

Hulme-Beaman, A., K. Dobney, T. Cucchi, and J.B. Searle. 2016. An ecological and evolutionary framework for commensalism in anthropogenic environments. Trends in Ecology & Evolution 31:633–645.

Huey, R.B., P.H. Niewiarowski, J. Kaufmann, and J.C. Herron. 1989. Thermal biology of nocturnal ectotherms: is sprint performance of geckos maximal at low body temperatures? Physiological Zoology 62:488–504.

Jadin, R.C., and J.L. Coleman. 2007. New county records of the Mediterranean House Gecko (*Hemidactylus turcicus*) in northeastern Texas, with comments on range expansion. Applied Herpetology 4:90–94.

Kluge, A.G. 1969. The evolution and geographical origin of the New World *Hemidactylus mabouia-brookii* complex (Gekkonidae, Sauria). Miscellaneous Publications Museum of Zoology, University of Michigan, no. 138. 78 p.

Litmer, A.R., and C.M. Murray. 2019. Critical thermal tolerance of invasion: comparative niche breadth of two invasive lizards. Journal of Thermal Biology 86:102432. https://doi.org/10.1016/j.jtherbio.2019.102432

Locey, K.J., and P.A. Stone. 2006. Factors affecting range expansion in the introduced Mediterranean Gecko, *Hemidactylus turcicus*. Journal of Herpetology 40:526–530.

Locey, K.J., and P.A. Stone. 2008. Ontogenetic factors affecting diffusion dispersal in the introduced Mediterranean Gecko, *Hemidactylus turcicus*. Journal of Herpetology 42:593–599.

McPherson, R.A., C. Fiebrich, K.C. Crawford, R.L. Elliott, J.R. Kilby, D.L. Grimsley, J.E. Martinez, J.B. Basara, B.G. Illston, D.A. Morris, et al. 2007. Statewide monitoring of the mesoscale environment: a technical update on the Oklahoma Mesonet. Journal of Atmospheric and Oceanic Technology 24:301–321.

Meshaka, W.E., Jr., B.P. Butterfield, and J.B. Hauge. 2004. The Exotic Amphibians and Reptiles of Florida. Krieger Publishing, Melbourne, Florida, USA.

Meshaka, W.E., Jr., S.D. Marshall, J. Boundy, and A.A. Williams. 2006. Status and geographic expansion of the Mediterranean Gecko, *Hemidactylus turcicus*, in Louisiana: implications for the Southeastern United States. Herpetological Conservation and Biology 1:45–50.

Nelson, D.H., and S.D. Carey. 1993. Range extension of the Mediterranean Gecko (*Hemidactylus turcicus*) along the northeastern Gulf Coast of the United States. Northeast Gulf Science 13:53–58.

Nordberg, E.J., T.A. Blanchard, V.A. Cobb, A.F. Scott, and R.S. Howard. 2013. Distribution of a non-native gecko (*Hemidactylus turcicus*) in Tennessee. Journal of the Tennessee Academy of Science 88:64–66.

Paulissen, M.A., and T.M. Buchanan. 1991. Observations on the natural history of the Mediterranean Gecko, *Hemidactylus turcicus* (Sauria; Gekkonidae) in northwest Arkansas. Journal of the Arkansas Academy of Science 45:81–83.

R Core Team. 2020. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. http://www.R-project.org.

Rödder, D., and S. Lötters. 2009. Niche shift versus niche conservatism? Climatic characteristics of the native and invasive ranges of the Mediterranean House Gecko (*Hemidactylus turcicus*). Global Ecology and Biogeography 18:674–687.

Rose, F.L., and C.D. Barbour. 1968. Ecology and reproductive cycles of the introduced gecko, *Hemidactylus turcicus*, in the southern United States. American Midland Naturalist 79:159–168.

Ruhe, B.M., T.C. LaDuke, K. Taylor, C.A. Urban, and J.L. Poston. 2019. The Mediterranean Gecko (*Hemidactylus turcicus*) in Pennsylvania, USA. Herpetological Review 50:536–537.

Selcer, K.W. 1986. Life history of a successful colonizer: the Mediterranean Gecko, *Hemidactylus turcicus*, in southern Texas. Copeia 1986:956–962.

Stabler, L.B., W.L. Johnson, K.J. Locey, and P.A. Stone. 2011. A comparison of Mediterranean Gecko (*Hemidactylus turcicus*) populations in two temperate zone urban habitats. Urban Ecosystems 15:653–666.

Wessels, J.L., E.T. Carter, C.L. Hively, L.E. Hayter, and B.M. Fitzpatrick. 2018. Population viability of nonnative Mediterranean House Geckos (*Hemidactylus turcicus*) at an urban site near the northern invasion front. Journal of Herpetology 52:215–222.

Weterings, R., and K.C. Vetter. 2017. Invasive House Geckos (*Hemidactylus* spp.): their current, potential and future distribution. Current Zoology 2017:1–15.

White, J.W., M.S. Husak, and R.E. Willis. 2016. Geographic distribution of the nonnative Mediterranean Gecko (*Hemidactylus turcicus*) in Oklahoma. Southwestern Naturalist 61:338–341.

York, J.R, and T.A. Baird. 2017. Sexual selection on male Collared Lizard (*Crotaphytus collaris*) display behaviour enhances offspring survivorship. Biological Journal of the Linnean Society 122:1–8.

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Allyson Fenwick is an Associate Professor at the University of Central Oklahoma, Edmond, USA, in the Department of Biology. She received her B.S. in Zoology and B.A. in Theatre from Michigan State University, East Lansing, USA, her M.S. in Biology from the University of Texas at Tyler, USA, and her Ph.D. in Conservation Biology from the University of Central Florida, Orlando, USA. Her Master's thesis recovered evolutionary relationships among South American pitvipers using morphology, and her dissertation recovered relationships among all pitvipers using morphology and DNA. Allyson currently focuses on invasion biology, specifically population genetics and ecology of Mediterranean Geckos. (Photographed by Gregory Territo).