
STATUS, DISTRIBUTION, AND ECOLOGY OF THE MIMIC GLASS LIZARD (*OPHISAURUS MIMICUS*)

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Abstract.—The Mimic Glass Lizard (*Ophisaurus mimicus*) is endemic to the Coastal Plain of the southeastern U.S. To assess its current status and distribution, we compiled 84 historical (pre-2000) and 45 recent (2000–2022) records by searching museum collections, databases, and the literature. We conducted field visits to 38 recent and 40 historical Mimic Glass Lizard sites to evaluate habitat type and condition. Most records are from open-canopied, hydric–mesic, fire-managed Longleaf Pine (*Pinus palustris*) habitats with grassy ground cover, including mesic and wet pine flatwoods (61 sites, 78.2%), wet prairie (13 sites, 16.6%), and seepage slope (five sites, 6.4%) communities. The range of the species is now highly fragmented, with recent records restricted to conservation lands in the Florida Panhandle (n = 4) and adjacent southern Alabama (n = 1), and near the coast in southeastern North Carolina (n = 2). Specimens are seldom collected in the field but have been found on roads and in funnel traps along drift fences. We summarized size data, survey methods, and activity of this poorly known species. Given the evidence of range-wide population declines, few recent records, and few known sites for Mimic Glass Lizards, we recommend immediate conservation attention by state and federal agencies, including a species status review for listing under the Endangered Species Act.

Key Words.—activity; conservation; fire; Longleaf Pine habitat; reptile; survey methods

INTRODUCTION

The Mimic Glass Lizard (*Ophisaurus mimicus*) is the smallest of four glass lizard species native to the southeastern U.S., reaching a maximum snout-vent length (SVL) of 183 mm and a maximum total length (TL) of 654 mm (Powell et al. 2016). Named for its close resemblance to the Eastern Slender Glass Lizard (*Ophisaurus attenuatus longicaudus*), which reaches 359 mm SVL and 1,180 mm TL, the Mimic Glass Lizard differs in being markedly smaller, having fewer scale rows along the lateral fold, lacking longitudinal black lines below the lateral fold, and having relatively larger dorsal scales (McConkey 1954; Palmer 1987; Moler 2019). Although the range of the Mimic Glass Lizard extends close to the coast in North Carolina, Florida, Georgia, and Alabama, it has never been recorded from any barrier island, unlike Eastern (*O. ventralis*) and Island (*O. compressus*) glass lizards

(Palmer and Braswell 1995). The Mimic Glass Lizard inhabits hydric or mesic Longleaf Pine (*Pinus palustris*) - Wiregrass (*Aristida stricta*) flatwoods and savannas and herbaceous bogs embedded in these habitats. Rarely, individuals have been documented from more xeric communities. An intact, dense, and diverse graminaceous ground cover maintained by frequent fires seems to be characteristic of sites with populations (Palmer 1987; Moler 2019). Longleaf Pine Savannas once covered much of the southeastern Coastal Plain of the USA but currently occupy < 3% of their original area due to human land use and fire suppression (Ware 1993; Frost 2006; Peet 2006).

Since Palmer (1987) described the Mimic Glass Lizard, little has been published on the species. Reichling (2008) provided an interesting account of its discovery and scientific description. Powell et al. (2016) erroneously included southeastern Louisiana within the range of the species. Palmer (1992) mapped a

questionable record from Long Pine Key in Everglades National Park in Florida; this specimen was later determined to be an Eastern Slender Glass Lizard (Moler 2019). We initiated this study to determine the current status and distribution of the Mimic Glass Lizard after realizing that it might be imperiled based upon the lack of recent records from many historical sites. The Mimic Glass Lizard was added as a Candidate Category 2 Species for listing consideration (with population status described as declining) by the U.S. Fish and Wildlife Service (USFWS) in 1994 (USFWS 1994). This listing classification system was discontinued in 1996 (USFWS 1996). As of January 2022, the species was considered extirpated in Mississippi, listed as Endangered in North Carolina, and listed as Rare in Georgia. It is not ranked by the state heritage program in South Carolina because of lack of data or survey effort (Andrew Grosse, pers. comm.). It is classified as of Highest Conservation Concern in the 2012 State Wildlife Action Plan (SWAP) of Alabama, making it illegal to possess without a special permit. It is also classified as a priority species in the SWAPs of all other states within its range except for Florida, where the state wildlife agency has recently identified determining its status and distribution as a medium-priority research information need.

MATERIALS AND METHODS

To evaluate the current conservation status of the Mimic Glass Lizard, we compiled all historical (pre-2000) and recent (2000–2022) records from the following sources: (1) museums (including a search of VertNet, www.vertnet.org); (2) literature; (3) databases of state heritage programs; (4) iNaturalist (www.inaturalist.org); (5) HerpMapper (www.herpmapper.org), and; (6) credible sightings by experts. We have extensive experience identifying Mimic Glass Lizards, which are often confused with other *Ophisaurus* species. We verified photographs, and when possible, vouchered them in the Herpetology Collection of the Florida Museum of Natural History of the University of Florida (UF). We only considered an observation without a photograph as credible if the person had substantial experience with *Ophisaurus* identification and saw it at a known Mimic Glass Lizard site (all such records were from Florida).

For each record, we included site code, source (e.g., voucher number, photograph), state, county, location (public land, road directions from nearest town), latitude, longitude, collector or observer, month, day, year, sex, SVL, tail length (TLL), and activity of specimen when found. We also noted whether the specimen was found alive (AOR) or dead (DOR) on a road, captured in a drift-fence trap, or found incidentally in the field. For each unique location, we assigned a site code (e.g.,

OMIM-MS-01 is one of three sites in Mississippi); sites with multiple records had multiple entries (e.g., five specimens found at site OMIM-FL-61).

To assess the effectiveness of drift fences at detecting Mimic Glass Lizards, we compiled *Ophisaurus* capture data for 49 survey sites located throughout the known or suspected range of the species (Supplemental Information Table S1). We omitted a few sites that failed to capture any *Ophisaurus*. We only considered drift fence/funnel trap sites installed in upland or wetland habitats potentially suitable for Mimic Glass Lizards. We included records of Mimic Glass Lizards found close to fence sites as well as records based on trap-captures.

In 2021–2022, we visited Mimic Glass Lizard sites and evaluated habitat characteristics and condition of upland or wetland habitats known to be used by the species (Fig. 1). We classified habitat types according to the most recent classification scheme of the Florida Natural Areas Inventory (FNAI 2010) and consulted publications specific to the natural communities of North Carolina (Schafale and Weakley 1990; Schafale 2012). For the purposes of this study, habitat accounts and descriptions used in the FNAI classification scheme adequately represented habitats used by the species throughout its range. In the following, Florida habitat types at Mimic Glass Lizard sites are followed in parentheses by the corresponding habitat type(s), if present, in North Carolina (Schafale 2012): sandhill (pine/scrub oak sandhill), upland pine forest, mesic pine flatwoods (mesic pine savanna), wet pine flatwoods (wet pine flatwoods, sandy pine savanna), wet prairie (wet loamy pine savanna), and seepage slope. Forested or shrubby wetland habitats (pocosins, shrub bogs, cypress swamps, creek swamps) are not considered primary habitats for the species and were not assessed.

We conducted habitat assessments by walking about 75 m in each cardinal direction from the coordinates provided for the record and carefully identifying and evaluating vegetation while completing a datasheet. We recorded information specific to forest type (natural uneven-age stand/plantation): (1) forest age (young/middle/mature); (2) habitat type; (3) dominant vegetation (canopy, subcanopy, shrub, and ground cover); and (4) percentage cover of canopy, shrub, and ground cover (< 25%; 25–50%; 51–75%; 76–100%). Because intact, grassy ground cover is important to the Mimic Glass Lizard, we characterized ground cover characteristics as intact or not intact; the latter designation indicating profound soil disturbance from historical land use involving heavy equipment, such as farming or bedding from silviculture. We also recorded whether bunchgrasses (Wiregrass and dropseed, *Sporobolus* spp.), which are indicator species of intact ground cover (Fill et al. 2016), were present and whether they were



FIGURE 1. Habitats of sites in which Mimic Glass Lizards (*Ophisaurus mimicus*) sites were found in 1990–2021: (A) Open Bog, seepage slope in Blackwater River State Forest, Okaloosa County, Florida, USA; (B) Crawford Bog, seepage slope in Conecuh National Forest, Covington County, Alabama, USA; (C) wet prairie in Apalachicola National Forest, Liberty County, Florida; (D) Shoestring Savannah, mesic pine flatwoods in Green Swamp Preserve, Brunswick County, North Carolina, USA. (Photograph A by Kevin Enge, B and D by Dirk Stevenson, and C by Pierson Hill).

abundant, common, or rare. We classified ground cover as mostly graminaceous, grass-shrub mix, or shrub-dominated. We classified fire history as: (1) excellent/good (open-canopied or somewhat open-canopied sites, possessing fire scars on woody vegetation and intact groundcover layers that appeared to have been burned approximately every 2–3 y); (2) fair (shaded or shrubby sites that would benefit from more frequent burning); or (3) poor (severely fire-suppressed, shaded sites with hardwoods and dense shrubs). Site habitat assessments were qualitative, with habitat condition ranks and vegetation scores based on visual estimates.

When a site record was based on a specimen found AOR or DOR, we noted whether habitat type, vegetation characteristics, or management history differed on opposite sides of the road. When analyzing habitat condition data for sites with different habitat scores on opposite sides of the road, we used the superior habitat condition rank of the two scores. Based on a review of the literature (Palmer 1987; Means 2006; Beane et al. 2010; Moler 2019), we considered the following habitat characteristics to represent optimal conditions for the Mimic Glass Lizard: (1) natural, uneven-aged stand/mature forest; (2) Longleaf Pine dominant in canopy; (3) < 25% canopy cover; (4) hardwoods absent in subcanopy; (5) ground cover intact, 76–100%, and mostly graminaceous; (6) Wiregrass abundant; and (7) shrub cover < 25%.

We obtained size data by examining preserved Mimic Glass Lizard specimens collected 1987–2021 in the North Carolina State Museum (NCSM), Georgia

Southern University (GSU), and UF collections. We measured SVL from tip of the snout to the posterior tip of the vent, and TLL to the nearest mm by carefully extending the tail of the specimen to its full length along a ruler. We combined these data with linear measurements (SVL and TLL) of museum specimens recorded by William Palmer prior to 1987. For specimens possessing complete tails, we calculated TL by adding SVL and TLL. We determined sex by everting hemipenes or based on coloration and pattern. Males ≥ 110 mm SVL possess pale, irregular dorsal crossbars with dark margins or traces of crossbars in the form of pale and dark speckling (Fig. 2), which are readily observed on preserved specimens (Palmer 1987). We considered specimens < 125 mm SVL to be juveniles, as the smallest mature male examined by Palmer (1987) measured 125 mm SVL. Depending on whether parametric assumptions were met or not, we performed non-parametric Kruskal-Wallis tests for male/female comparisons of length ($\alpha = 0.05$). We used a One-Proportion Z test to determine if there was an uneven sex ratio among records where sex was noted.

RESULTS

We compiled 132 Mimic Glass Lizard records: 90 museum specimens; nine literature records; 12 records from internet sites (iNaturalist, HerpMapper, Facebook); two records based on photographs; and 19 records based on credible sightings (Fig. 3; Supplemental Information Tables S2–S4). Of these, we considered 84 historical



FIGURE 2. (A) Male, (B) female, and (C) juvenile Mimic Glass Lizards (*Ophisaurus mimicus*) from Apalachicola National Forest, Liberty County, Florida, USA. (Photographed by Pierson Hill).

(pre-2000) records and 45 recent (2000–2022) records. Records by decade are 1850s (one), 1940s (three), 1950s (nine), 1960s (seven), 1970s (26), 1980s (21), 1990s (17), 2000s (10), 2010–2022 (35), and year unknown (three).

Alabama.—Alabama has seven records from six sites in four counties from 1853 to 2006, including three recent records (Supplemental Information Table S3; Fig. 3). The sole public land with records is Conecuh National Forest (Supplemental Information Table S3). The species had not been documented in Alabama for about 30 y (1976–2006) until two specimens were trapped in 2006 by the same drift fence at Crawford

Bog on Conecuh National Forest, Covington County (Supplemental Information Table S1). Crawford Bog is considered the largest and best-managed pitcher plant (*Sarracenia* spp.) bog on the forest (Fig. 1). The late George Folkerts of Auburn University reported a credible observation about 2000 from Curious Bog on Conecuh National Forest, Escambia County. The single historical site we visited is on private land and is fire-suppressed and in poor condition; characteristic herb bog vegetation was still present in a roadside ditch. The Splinter Hill Bog Preserve of The Nature Conservancy (TNC) in Baldwin County is an 850-ha tract containing extensive potential Mimic Glass Lizard habitat.

Florida.—Florida has 78 records from 63 sites in nine counties from 1966 to 2022, with 34 records being recent (Supplemental Information Table S2; Fig. 3). Number of records by decade are 1960s (three), 1970s (12), 1980s (11), 1990s (15), 2000s (5), 2010–2022 (29), and unknown (three). Public lands with records are the Apalachicola National Forest in Franklin and Liberty counties; Eglin Air Force Base in Okaloosa, Santa Rosa, and Walton counties; Holley Naval Outlying Landing Field in Santa Rosa County; Tate’s Hell State Forest in Franklin County; Blackwater River State Forest in Okaloosa and Santa Rosa counties; and St. Mark’s National Wildlife Refuge in Wakulla County (Supplemental Information Table S2). We confirmed the identification of a 1969 specimen from Duval County examined by Palmer, which is the only record from peninsular Florida (Supplemental Information Table S2). Extant, widely fragmented populations are now limited to the Panhandle region of northwestern Florida. An old specimen examined by Palmer from Pensacola represents the only record from Escambia County (Supplemental Information Table S2). Sixty records overall (76.9%) and 30 (88.2%) of recent records are from Eglin Air Force Base (14 records total, with two recent records) and Apalachicola National Forest (46 records total, with 28 recent records; Supplemental Information Table S2). These properties and Blackwater River State Forest are protected sites with a long history of fire management and represent population strongholds for the species. Drift-fence captures of Mimic Glass Lizards were recent on the three conservation lands mentioned above but were historical on Holley Naval Outlying Landing Field and St. Marks National Wildlife Refuge (Supplemental Information Table S1). Conservation lands with potential to support populations are Point Washington State Forest, Escribano Point Wildlife Management Area (WMA), Garcon Point Water Management Area, and Tarkiln Bayou Preserve State Park.

Georgia.—Georgia has nine records from nine sites in seven counties from 1953 to 1993 (Supplemental

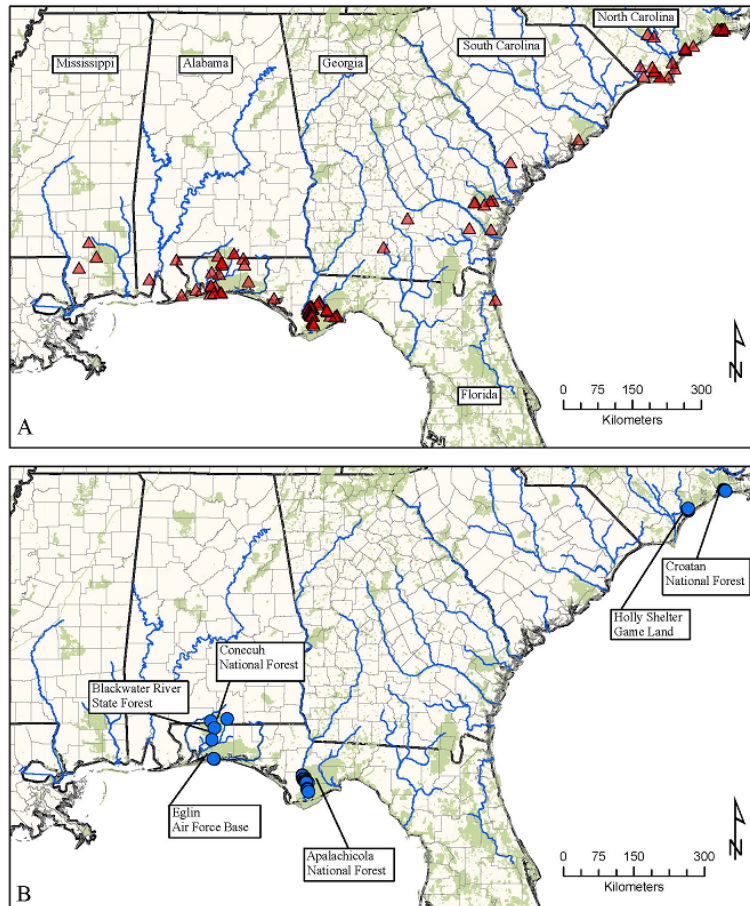


FIGURE 3. Maps of the Southeastern USA showing (A) all records and (B) recent records (2000–2022) of the Mimic Glass Lizard (*Ophisaurus mimicus*).

Information Table S3; Fig. 3). The sole public land with records is the Fort Stewart Military Installation in southeastern Georgia, which has five records (four from roads; Supplemental Information Table S3). The Red Hills physiographic region lacks any records. Road-cruising, visual encounter surveys, and drift-fence surveys conducted in 1992–2007 along the margins of isolated cypress ponds in mesic pine flatwoods throughout Fort Stewart detected a single Mimic Glass Lizard but numerous Eastern Slender Glass Lizards and Eastern Glass Lizards (pers. obs.). An intensive road-cruising survey in 2017–2019 for upland snake species, which included diurnal survey routes on the western side of Fort Stewart close to historical Mimic Glass Lizard collection sites in Long County, detected 17 Eastern Slender Glass Lizards and four Eastern Glass Lizards but no Mimic Glass Lizards (J.D. Willson, pers. comm.). A drift-fence survey conducted on Fort Stewart in 2022 near the 1993 record documented Eastern Slender Glass Lizards and Eastern Glass Lizards but no Mimic Glass Lizards (Supplemental Information Table S1). Extensive areas of former mesic Longleaf Pine-

Wiregrass habitats at or near the historical collection sites in Wayne and McIntosh counties now consist of bedded, fire-suppressed Slash Pine (*Pinus elliottii*) and Loblolly Pine (*P. taeda*) plantations (pers. obs.). It is extremely unlikely that populations persist in these areas. It is possible that localized populations still persist on Fort Stewart, and additional drift-fence surveys are scheduled for 2023. The 243-ha Doerun Pitcher Plant Bog WMA in Colquitt County and Mayhaw WMA in Miller County contain some suitable habitat.

Mississippi.—Mississippi has three records each from Forrest, Pearl River, and Perry counties from 1940 to 1953 (Supplemental Information Table S3; Fig. 3). Due to their age or vague locality information, we could not locate with certainty these collection sites; however, we assessed habitat conditions at a protected site in the De Soto National Forest (see OMIM-MS-01) that roughly corresponds to the collection information for the Forrest County specimen (Supplemental Information Table S3), which was “Forrest County: 3.2 km S Brooklyn.” Apparently, this and the Perry

County specimen from “US Rte. 98, SE Hattiesburg” (Supplemental Information Table S3) were both found on or very near what are now De Soto National Forest lands. Recent drift-fence surveys in suitable Mimic Glass Lizard habitat have failed to detect the species (Supplemental Information Table S1). It is conceivable that small, remnant populations persist somewhere in Mississippi, especially in the bog and Longleaf Pine sites surveyed by Lee and Sisson (Supplemental Information Table S1). The Mississippi Sandhill Crane National Wildlife Refuge and a graminoid marsh site known as White’s Pond in Forrest County also have potential.

North Carolina.—North Carolina has 33 records from 28 sites in eight counties from 1949 to 2022, with eight records being recent (Supplemental Information Table S4; Fig. 3). Numbers of records by decade are 1940s (two), 1950s (four), 1960s (four), 1970s (five), 1980s (nine), 1990s (one), 2000s (two), 2010–2022 (six). All recent records are from Croatan National Forest ($n = 4$; Carteret County) and Holly Shelter Game Lands ($n = 4$; Pender County; Supplemental Information Table S4). Both of these public lands contain vast, well-managed (e.g., regular prescribed fire) areas of suitable habitat and are of immense importance to the conservation future of the Mimic Glass Lizard. Historical records exist from Bay Tree Lake State Park, Green Swamp Preserve (TNC), and Green Swamp Game Lands (Supplemental Information Table S4). Except for two historical records from Bladen and Sampson counties, the range of the species hugs the coast; recent attempts to rediscover Mimic Glass Lizards near these sites by intensive road-cruising surveys have been unsuccessful (Christopher Akcali, pers. comm.). Suitable habitat remains in portions of the Green Swamp region and Military Ocean Terminal Sunny Point in Brunswick County, and Camp Lejeune in Onslow County.

South Carolina.—South Carolina has two records from one site each in Berkeley and Jasper counties from 1978 and 1984 (Supplemental Information Table S4; Fig. 3). We discount a more recent record from Jasper County mapped by Camper (2019; based on an observation from 1996) that lacks a voucher specimen or photograph. The specimen collected in 1984 in Jasper County (Supplemental Information Table S4) came from private property that is now lightly developed with pine habitats degraded from commercial forestry practices or fire suppression. The only public land with records is Francis Marion National Forest, where Longleaf Pine ecosystems at or near the historical site are fire-suppressed, shrub-dominated in the understory layer, and unlikely to support a population (see OMIM-SC-01; Supplemental Information Table S4). Despite the frequent presence of herpetologists on Francis

Marion National Forest over the last 15 y, no Mimic Glass Lizards have been documented (Andrew Grosse, pers. comm.), but Eastern Slender Glass Lizard and Eastern Glass Lizard populations are present (Ben Morrison, pers. comm.). Recent drift-fence surveys in mesic flatwoods have failed to detect the species (Supplemental Information Table S1). The lack of an effective sampling or collection technique to detect the Mimic Glass Lizard is viewed as an issue, and recent survey efforts have not targeted the species (Andrew Grosse, pers. comm.). Potentially suitable habitat may still be found on isolated portions of the Francis Marion National Forest, Santee Coastal Reserve, the James W. Webb Wildlife Center and WMA, and on privately owned quail plantations in Jasper County.

Habitat assessment.—We classified habitat characteristics and condition at 78 Mimic Glass Lizard sites, including 40 historical sites and 38 recent sites. Sixty-one (78.2%) sites were located in mesic pine flatwoods or wet pine flatwoods habitats; 13 (16.6%) sites were located in wet prairie habitat; five (6.4%) sites were in seepage slope habitat; and 16 (20.5%) sites were located in upland pine or sandhill habitats. Multiple habitat types were present at several sites. Longleaf Pine or Slash Pine were the dominant or co-dominant pine species at almost all sites (Fig. 1). Sites with recent records tended to be open-canopied or somewhat open-canopied ($n = 36$; 94.7%), lack a midstory ($n = 36$; 94.7%), and have graminaceous ($n = 27$; 71.1%) or graminaceous-shrub ($n = 9$; 24.3%) dominated ground covers with common to abundant bunchgrasses ($n = 34$; 89.7%; Fig. 1). With respect to fire history, we ranked 32 (84.2%) of recent sites as good, four (10.8%) as fair, and two (5.4%) as poor.

Size and sex.—Males and females were not significantly different in SVL ($H = 0.308$, $df = 1$, $P = 0.579$), TLL ($H = 0.944$, $df = 1$, $P = 0.331$), or TL ($H = 0.458$, $df = 1$, $P = 0.499$; Table 1). Tail length

TABLE 1. Linear measurement (mm) data for museum specimens of the Mimic Glass Lizard (*Ophisaurus mimicus*) with snout-vent length (SVL) >120 mm. Abbreviations are TL = total length, TLL = tail length, SD = standard deviation.

Sex	Measurement	N	Mean \pm SD (range)
Male	SVL	41	149 \pm 17.6 (122–203)
	TL	20	559 \pm 56.8 (450–657)
	TLL	20	406 \pm 40.8 (328–476)
Female	SVL	22	152 \pm 12.7 (129–175)
	TL	11	546 \pm 26.5 (509–586)
	TLL	11	398 \pm 18.6 (362–427)
Combined	SVL	63	150 \pm 16.0 (122–203)
	TL	31	554 \pm 48.2 (450–657)
	TLL	31	403 \pm 34.4 (328–476)

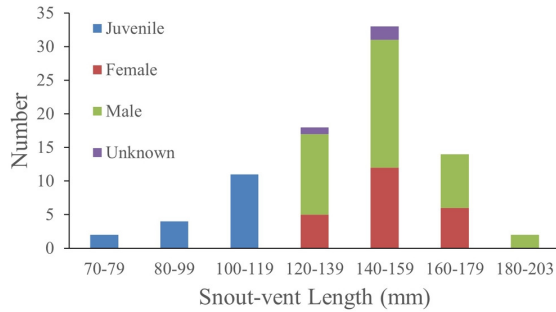


FIGURE 4. Size distribution data for Mimic Glass Lizard (*Ophisaurus mimicus*) records compiled by this study.

averaged 72% of TL (mean for both sexes combined), and there was no significant difference in relative tail length (TLL/TL) between males and females ($df = 1$, $H = 0.10$, $P = 0.75$). Our sample includes 46 of 83 (55.4%) specimens with complete tails (Supplemental Information Tables S2-S4). Lizards that we found ranged in size from 70 to 203 mm SVL, and the most common size class were individuals 140–159 mm SVL (Fig. 4). Hatchlings have not been described, but we suspect that the two smallest specimens we examined, which measured 70 mm SVL on 7 September and 74 mm SVL on 29 March, represented animals during their first year of life. The largest male (UF 178203) that we examined (203 mm SVL; 446 mm TL), which was collected in Franklin County, Florida (Supplemental Information Table S2), represents the maximum size record for the species.

Ecology.—The Eastern Glass Lizard, the most ubiquitous species of glass lizard in the Coastal Plain of the southeastern U.S., was found in 47 of 49 drift-fence sites in suitable habitats for the Mimic Glass Lizard within its presumed range (Supplemental Information Table S1). Two sites without Eastern Glass Lizard detections, however, captured no *Ophisaurus* (Harrison County, Mississippi) or lacked data for this species (Holley Naval Outlying Landing Field). The Mimic Glass Lizard was found at 11 drift-fence sites in Florida, Alabama, and Georgia (Supplemental Information Table S1). Some *Ophisaurus* species may exhibit niche partitioning and geographic ecological replacement. The Island Glass Lizard has not been found syntopically with the Mimic Glass Lizard, whereas the Eastern Slender Glass Lizard and the Eastern Glass Lizard were encountered at the same sites as the Mimic Glass Lizard on Fort Stewart, Georgia, and in Apalachicola National Forest, Florida (Supplemental Information Table S1). At a mesic flatwoods site in northern peninsular Florida, three of the four *Ophisaurus* species (minus the Mimic Glass Lizard) were trapped together (Supplemental Information Table S1). All drift-fence captures for

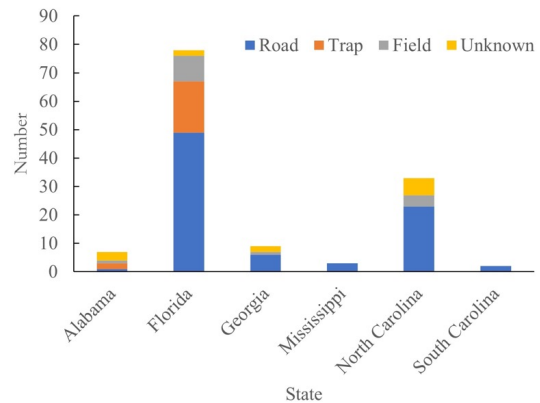


FIGURE 5. Methods used to detect Mimic Glass Lizards (*Ophisaurus mimicus*) by state.

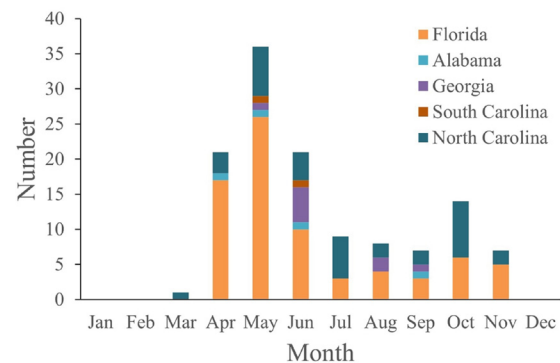


FIGURE 6. The number of Mimic Glass Lizards (*Ophisaurus mimicus*) observed per month by state.

which we have detailed information were in funnel traps instead of pitfall traps.

Our Mimic Glass Lizard records include 63 individuals found crossing roads (AOR = 36; DOR = 27) and 15 individuals captured in drift fences (Supplemental Information Tables S2-S4; Fig. 5). Fifteen specimens have been found on the surface by persons walking through pineland habitat during the daytime (Supplemental Information Tables S2-S4). The method of collection for the remaining records is unknown (Fig. 5), but we assume most of these were found on roads. Specimens have never been found beneath natural or anthropogenic cover like logs, boards, tin, bark, or similar debris.

Mimic Glass Lizards have been observed from 27 March to 16 November (Supplemental Information Tables S2-S4); 61.5% of 122 records with a collection month were from April-June, suggesting a pulse of surface activity during the spring and early summer (Fig. 6). Significantly more males than females are present in collections ($X^2 = 6.81$, $df = 1$, $P = 0.014$), suggesting greater surface activity and movement by males. The species exhibits diurnal, crepuscular, and nocturnal

activity. At least seven AOR specimens were found after dark, with the latest observed just after midnight, and others found near dusk (Supplemental Information Tables S2-S3).

DISCUSSION

Ophisaurus species are elusive, semifossorial, and cryptic, with seasonal activity tied closely to local weather conditions. Because *Ophisaurus* are infrequently observed, there is a dearth of published information relative to their natural history and behavior (Fitch 1989). Most Mimic Glass Lizards have been found on roads in April-June, which potentially corresponds with their breeding season. Other *Ophisaurus* species typically oviposit in June-July (Palmer and Braswell 1995). The preponderance of males found in April-June suggests they are actively searching for females. Specimens have also been trapped by drift fences and observed on the surface in pinelands, particularly in dense Wiregrass. Fitch (1989) reported rapid growth of young Western Slender Glass Lizards (*O. a. attenuatus*) from Kansas, with hatchlings (50–63 mm SVL) attaining 70–80 mm SVL by late September-November of their first year. The age of sexual maturity of Mimic Glass Lizards is probably around 3 y, similar to other *Ophisaurus* species (Fitch 1989). Although possessing fracture planes in the caudal vertebrae, the tails of Mimic Glass Lizards may be less frangible than those of Eastern Slender Glass Lizards and Eastern Glass Lizards (Palmer and Braswell 1995). We found that 55% of 83 Mimic Glass Lizards examined had complete tails, whereas Palmer (1987) found that 48% of 25 North Carolina specimens had complete tails.

Our comprehensive range-wide review of habitat types confirms that the Mimic Glass Lizard is a Longleaf Pine ecosystem endemic that requires hydric-mesic, savanna-like habitats characterized by extensive graminaceous vegetation (Palmer 1987; Moler 1992; Guyer and Bailey 1993; Means 2006). Palmer (1987) reported North Carolina specimens from open, park-like, and recently burned Longleaf Pine savannas and from sandy Longleaf Pine flatwoods with an open understory of scattered Turkey Oaks (*Quercus laevis*) and ericaceous shrubs with Wiregrass as the dominant ground cover. Several Mimic Glass Lizard records are from sandhills and upland pine forests, which have well-drained, sandy or loamy clay soils that often support Gopher Tortoises (*Gopherus polyphemus*) in the southern part of the range of the species. We suspect these are exceptional cases, and although individuals sometimes traverse sandhill or upland pine forest habitat, these are not their primary habitats. Sandhill records from sites in Apalachicola National Forest, Eglin Air Force Base, and Croatan National Forest are

from landscapes where low sand ridges occur within or proximal to extensive areas of pine flatwoods and/or wet prairie habitats. The available upland pine forest records for Blackwater River State Forest are, in most cases, along or near ecotones with seepage slope bog habitats. Similarly, the Conecuh National Forest records are from seepage slope bogs at the base of upland pine forest communities. In the lower Coastal Plain, where slight changes in elevation often correspond to different soil types, the upland (mesic and wet pine flatwoods) and wetland (wet prairie, seepage slope) habitats used by Mimic Glass Lizards, typically grade into one another and into other habitats (e.g., sandhills, cypress ponds, pocosins) over short distances.

Lightning-ignited fires have likely been an evolutionary force in the southeastern Coastal Plain for millions of years (Noss 2013; Noss et al. 2015). Many endemic Coastal Plain taxa inhabit pine savannas, suggesting these ecosystems evolved with and were maintained by fires set by lightning instead of humans (Noss 2013). Because the Mimic Glass Lizard lives in fire-dependent habitats, it likely possesses behavioral adaptations to avoid growing-season fires, but survival may vary depending on season or intensity of burns. Fire is a documented source of mortality for the Eastern Glass Lizard (Russell et al. 1999; Kaufman et al. 2007). Babbitt and Babbitt (1951) found 24 dead and 33 live Eastern Glass Lizards along a 30-m-long burned area adjacent to a highway in southern Florida. Means and Campbell (1981) reported 15 dead and four live Eastern Glass Lizards after a prescribed fire and stated that only this reptile species appears to experience significant direct mortality from prescribed burns.

Several reptile species shelter in the burrows of burrowing crayfishes (Neill 1951), and these burrows could provide Mimic Glass Lizards shelter from fire, drought, and predators. At 2030 on 24 May 2021, Pierson Hill observed an adult Mimic Glass Lizard attempt to escape into an abandoned Seepage Crayfish (*Procambarus rogersi*) burrow at a recently burned wet prairie site in Apalachicola National Forest (Supplemental Information Table S2). Other species of burrowing crayfish that are often abundant in herb bog, seepage slope, and mesic-wet pine flatwoods communities include the Lavender Burrowing Crayfish (*Creaserinus byersi*) of western Florida and southern Alabama, the Burrowing Bog Crayfish (*C. burrisi*) of southern Alabama, and the Vidalia Crayfish (*P. advena*) of southeastern Georgia.

Like many Longleaf Pine ecosystem specialists, Mimic Glass Lizard populations have probably declined due to habitat loss and fragmentation, and degradation of habitat quality particularly from fire suppression or burning during inappropriate seasons (Guyer and Bailey 1993; Means 2006; Reichling 2008). The likely former

range of this species in Alabama has been grossly dissected by development and habitat conversion and degradation from agriculture and commercial forestry practices (Guyer et al. 2019). According to Folkerts (1982), “the absence of fire inevitably results in the eventual elimination of these bog species and the bog itself” as Coastal Plain bog communities are invaded by various plant species including Wax Myrtle (*Myrica cerifera*), Gallberry (*Ilex glabra*), Swamp Titi (*Cyrilla racemiflora*), St. John’s wort (*Hypericum* spp.), Sweetbay (*Magnolia virginiana*), Slash Pine, Greenbrier (*Smilax laurifolia*), ferns (Polypodiophyta), and Black Gum (*Nyssa sylvatica*). Historically, periodic fires sweeping downslope from adjacent Longleaf Pine forests maintained open, grassy herb bog habitats, but fire-sensitive evergreen shrubs prevalent downhill in wetter areas will invade upslope into herb bogs in the absence of fire (Means and Moler 1978). Currently, only 1% of seepage slopes that originally existed in the Gulf Coastal Plain are still intact (FNAI 2010)

Today, the distribution of the Mimic Glass Lizard is highly fragmented and restricted to seven public lands where active prescribed fire management, including some growing-season (May-August) burns, has been ongoing for some time. Most Florida records are from Eglin Air Force Base and Apalachicola National Forest. Habitat management at Eglin Air Force Base, which has one of the most active prescribed burning programs in the country, serves to create and maintain quality upland and wetland habitats that support high herpetofaunal diversity (Erwin et al. 2016). Similarly, Apalachicola National Forest and Blackwater River State Forest in Florida and Croatan National Forest and Holly Shelter Game Lands in North Carolina are well known for their biodiverse, fire-managed landscapes that support many imperiled and endemic species (Wolfe et al. 1988). In Apalachicola National Forest, Trager et al. (2018) ranked the ecological condition of Longleaf Pine habitats as excellent, good, fair, poor, or very poor. They ranked 23.2% of 101,040 ha of pine flatwoods and 19.4% of 13,962 ha of wet prairies as being in excellent or good ecological condition; 35.4% of historical wet prairie acreage was considered in very poor condition because of plantation silviculture or shrub and tree encroachment. Approximately 10% of historical wet prairie acreage in Apalachicola National Forest is within two management areas (MA 2.1 and MA 3.1) near Sumatra and Wilma that recognize the ecological value of wet prairies and manage them using frequent prescribed fire (Trager et al. 2018). The average ecological score of wet prairie sites in these two MAs was good, whereas it was poor elsewhere in Apalachicola National Forest, where only 13% of sites were ranked in excellent or good condition (Trager et al. 2018). Despite Apalachicola National Forest having one of the most active prescribed fire

programs in the U.S., it has lost an estimated 32,000 ha of grasslands to shrubby succession since 1937 (Hess 2014). This represents a 14% expansion of shrub-dominated communities into adjacent herb bogs and seepage slopes (Hess 2014).

Fire-management decisions affecting habitats used by Mimic Glass Lizards should be based on what is known about its natural history, as Bishop and Haas (2005) recommended for flatwoods salamanders (*Ambystoma bishopi* and *A. cingulatum*), and the historical fire regime of the Longleaf Pine ecosystem. Habitat management for the Red-cockaded Woodpecker (*Dryobates borealis*), which prefers areas with widely spaced mature pine trees, little or no midstory, and fire-maintained grassy and herbaceous ground cover (Conner et al. 2001), benefits Mimic Glass Lizard populations. Burning less frequently and burning predominantly during the dormant season have led to the loss of wet prairies through encroachment of shrubs and trees, even on conservation lands (Clewett et al. 2009; FNAI 2010; Hess 2014). In Apalachicola National Forest, over 3,000 ha of wet prairie ranked in fair ecological condition could be restored at relatively low cost by thinning trees through harvest and implementing short fire-return intervals and burning in March-June (Trager et al. 2018).

Habitat and ecological specializations of the Mimic Glass Lizard mirror those of the two flatwoods salamander species to a significant extent. Adults of these species are terrestrial and fossorial inhabitants of grassland-like environments that require dense, diverse ground cover, and undisturbed soils. These species are known from many of the same sites on Eglin Air Force Base and Apalachicola National Forest (USFWS 1999, 2008). In fact, five Mimic Glass Lizards were trapped or observed at drift fences installed along the margins of dome swamps in mesic flatwoods on Eglin Air Force Base to monitor Reticulated Flatwoods Salamander (*A. bishopi*) populations. The two MAs in Apalachicola National Forest with the most Mimic Glass Lizard records and extant populations of Frosted Flatwoods Salamanders (*A. cingulatum*) (Semlitsch et al. 2017) are managed for wet savannas and have high botanical diversity and endemism (Trager et al. 2018). Flatwoods salamander populations have disappeared from sites where gross changes to the native groundcover vegetation have occurred (Means et al. 1996; Palis 1996; USFWS 1999), and we strongly suspect the conservation status of the Mimic Glass Lizard is on a parallel trajectory. Mimic Glass Lizard populations are threatened by actions that profoundly disturb the ground cover, soils, or hydrology of the sensitive and poorly drained natural communities they inhabit. Disturbances can be anthropogenic (e.g., firebreaks, logging decks, skidder trails) or repetitive rooting by feral Pigs (*Sus scrofa*), which have grossly

damaged seepage bog habitats in Florida (Engeman et al. 2007; David Printiss and Dan Hipes, unpubl. report) and Georgia, including on Fort Stewart (pers. obs.).

Our study results indicate that the Mimic Glass Lizard is imperiled and has experienced population declines over much of its historical range; it currently occurs in a few scattered locations. Declines attributable to what is called extinction debt may threaten the future health of currently extant Mimic Glass Lizard populations (Semlitsch et al. 2017). The status of the Mimic Glass Lizard warrants immediate conservation attention from both state and federal agencies, and a federal species status review should be conducted as the first step for consideration of listing under the Endangered Species Act.

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