

Reptile Distributions on Islands in Lake Erie

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The herpetology of islands in western Lake Erie has been the subject of both popular and scientific work for more than half a century (e.g., Conant and Clay, 1937, 1963; Hatcher, 1945; McDermott, 1947, and references therein; Thomas, 1949; Langlois, 1951, 1953; Camin et al., 1954; Camin and Ehrlich, 1958; Ehrlich and Camin, 1960; Conant, 1965; Goldman, 1971; Downs, 1978; Reichenbach, 1981). However, comprehensive faunal surveys of many of the islands have never been published and only one paper (Langlois, 1964) has summarized available distributional data for the islands. Here, I present data on reptile distributions for nine islands as well as a biogeographic analysis of the effect of island size and distance to the mainland on reptile species number.

Data on reptile species distributions come from published records (Jones, 1912; Conant and Clay, 1937; Conant, 1951, 1965; Langlois, 1951, 1953, 1964; Logier and Toner, 1961; Kraus and Schuett, 1982; Oldham, 1983), from a survey of specimens in the Ohio State University F. T. Stone Laboratory collection (Put-in-Bay, Ohio) and from field work I conducted between 1979 and 1984. I visited each island repeatedly (4-46 times) during the study and searched suitable terrestrial and aquatic habitats for reptiles. Most reptiles were identified in hand using field guide descriptions (Conant, 1975; Behler and King, 1979) but occasionally basking individuals (mostly turtles) were identified without capture. Species were considered to be in the mainland species pool if they had been recorded in Lucas, Ottawa, Erie, or Sandusky counties in Ohio or in Essex or Kent counties in Ontario (Conant, 1951; Logier and Toner, 1961; Cook, 1984). Island areas and distances to the nearest mainland point were taken from Core (1948) or calculated from

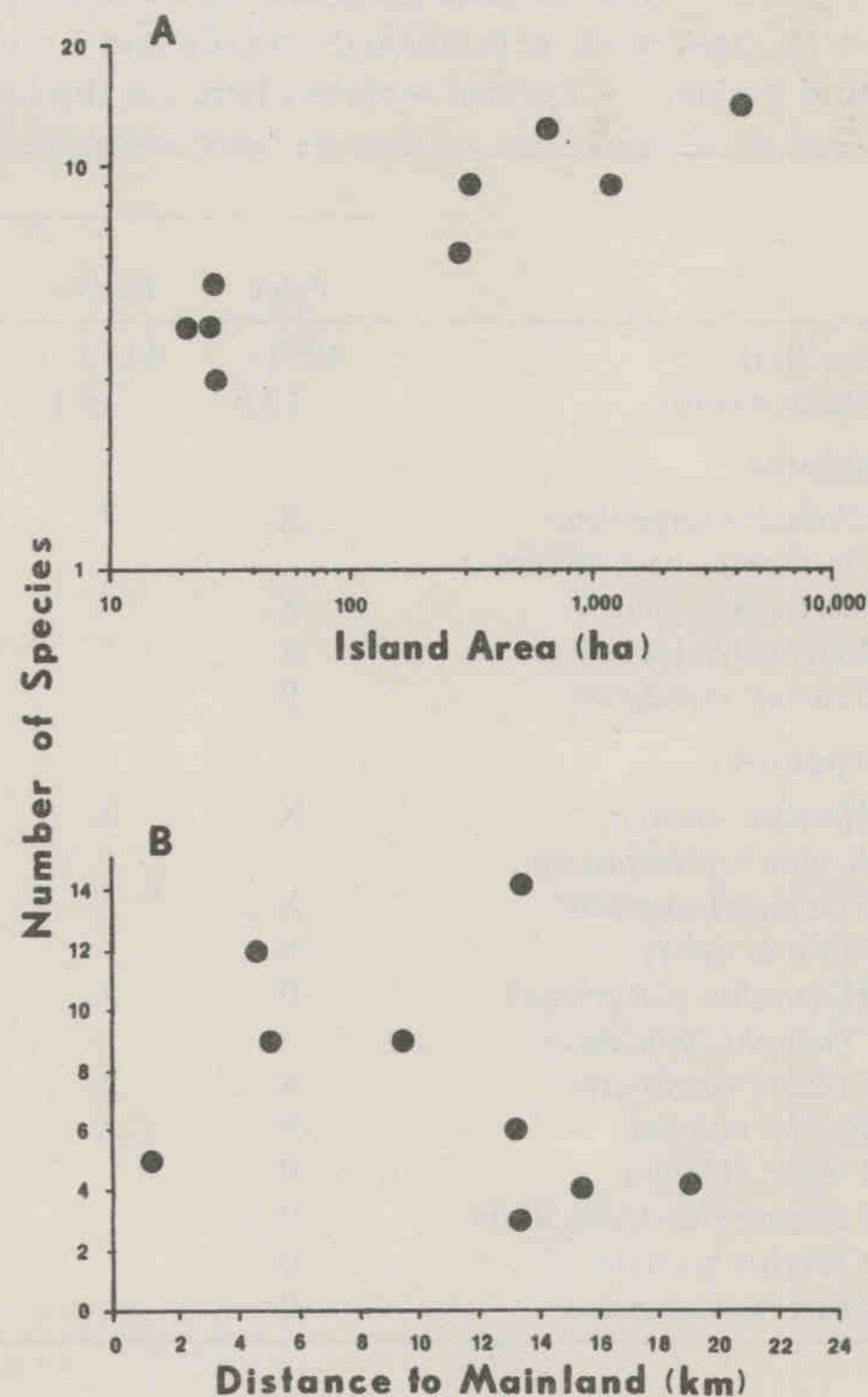


FIG. 1. Relationship of species number to (A) island area and to (B) distance to the mainland for reptiles on islands in Lake Erie. The regression equation for species number and area is $Y = 1.79X^{0.25}$ ($r^2 = 0.86$, $P = 0.0002$).

National Oceanic and Atmospheric Administration Chart #14830. The islands included in this analysis range from 1-20 km from the mainland and from 20-4000 ha. This represents the full range of distances and all but the smallest sizes found among the 20 islands in western Lake Erie (cf. map in King, 1986).

A total of 25 reptile species (8 turtles, 1 lizard, and 16 snakes) are found in the mainland species pool. Of these, 17 species (5 turtles and 12 snakes) occurred on at least one of the islands surveyed. Species found in adjacent mainland areas but absent from all islands include 3 turtles (*Clemmys guttata*, *Sternotherus odoratus*, *Terrapene carolina*), 1 lizard (*Eumeces fasciatus*), and 4 snakes (*Clonophis kirtlandi*, *Thamnophis butleri*, *Thamnophis sauritus*, *Opheodrys vernalis*). The number of reptile species on individual islands ranged from 3 to 14 (Table 1). The relationship between species number and island area was determined using least-squares regression on the logarithms (base 10) of both variables. Taking the anti-log of the resulting regression equation produces the power function model typically used to relate species number and island area. This analysis showed a significant positive correlation between species number and island area (Fig. 1). The value of the exponent of the

TABLE 1. Area, distance to the mainland, and occurrence of reptile species on islands in Lake Erie. Symbols: X = species listed in published records and found by me, 0 = species listed in published reports but not found by me, * = species reported here for the first time.

	Island								
	Pelee	Kellys	South Bass	Middle Bass	North Bass	West Sister	John-sons	East Sister	Middle
Area (ha)	4091	1169	673	300	282	28	27	26	21
Distance (km)	13.5	5.1	4.5	9.5	13.3	13.4	1.1	19.1	15.6
Chelonia									
<i>Chelydra serpentina</i>	X	*	0	X					
<i>Graptemys geographica</i>			0						
<i>Chrysemys picta</i>	X	*	X	X	X		*		
<i>Emydoidea blandingi</i>	X	*		X	X				
<i>Trionyx spiniferus</i>	0								
Serpentes									
<i>Nerodia sipedon</i>	X	X	X	X	X	0	*	*	X
<i>Regina septemvittata</i>		*					*		
<i>Thamnophis sirtalis</i>	X	X	X	X	X	X		X	X
<i>Storeria dekayi</i>	X		X	X	X			*	X
<i>Heterodon platyrhinos</i>	0	X	0						
<i>Diadophis punctatus</i>			X	*					
<i>Coluber constrictor</i>	X	X	X	X			*		
<i>Elaphe vulpina</i>	X	X	X	X	X	*	*	*	*
<i>Elaphe obsoleta</i>	0		0						
<i>Lampropeltis triangulum</i>	0								
<i>Crotalus horridus</i>	0		0						
<i>Sistrurus catenatus</i>	0								

power function, $z = 0.25$, fell within the range observed for reptiles on archipelagos elsewhere (Conner and McCoy, 1979; Wright, 1981). Species number was not correlated with distance to the mainland ($r^2 = 0.10$, $P = 0.20$) (Fig. 1). However, using partial correlation to remove the effect of island area revealed a nearly significant relationship between species number and distance to the mainland (coefficient of partial correlation = -0.56 , $P = 0.07$).

A number of species previously reported from some islands in Lake Erie were not observed at those sites in this study (Table 1) and may represent extinctions which occurred within the last 50 years. Although these extinctions could be the result of natural processes, they may also be due to human activities on the islands. Shoreline development, draining of wetlands, quarrying, and agriculture have reduced suitable reptile habitat and effectively decreased island area. Restricting analysis to current species distributions (those found in this study) had no qualitative effect on the results described above: there was a significant correlation between log species number and log area ($r^2 = 0.62$, $P = 0.006$), and species number and distance were uncorrelated after controlling for area (coefficient of partial correlation = -0.57 , $P = 0.07$).

Recent colonizations have also taken place on the Lake Erie islands. The queen snake, *Regina septemvittata*, was not recorded from Kellys Island prior to 1980 but I found several individuals there. This species feeds exclusively on crayfish (Godley et al.,

1984), and I observed high densities of these prey in ponds formed in abandoned quarries on that island. Prior to quarrying, sufficient prey may not have existed to support queen snake populations. There are no published records of reptile species on Johnsons Island so it is not possible to determine if queen snakes are recent colonists there, but recent quarrying operations have provided suitable habitat for both this snake and its prey. The ringneck snake, *Diadophis punctatus*, was not known from Middle Bass Island prior to a single individual found there in 1984. This may be a recent colonist from neighboring South Bass Island, the only other island from which this species is known. However, it is possible that these species were introduced by humans (either intentionally or inadvertently). Box turtles, *Terrapene carolina*, have recently been reported from Pelee Island and Point Pelee, Ontario, (Cook, 1984). Cook (1984) suggests, however, that these sightings are probably of escaped or released pets and for this reason this species was not included in the analysis above.

According to the equilibrium theory of island biogeography (MacArthur and Wilson, 1967), both island area and distance should influence species number. In particular, extinction rates should be inversely proportional to island area, and colonization rates should be inversely proportional to distance from the mainland. Species number was strongly correlated with island area but only weakly correlated with distance, suggesting that extinction has had a greater effect than colonization in determining reptile species

distributions on islands in Lake Erie. These islands are land-bridge islands consisting of resistant limestone and dolomite that remained after the retreat of the Wisconsin glaciation. They were isolated from the mainland by rising lake levels about 4000 yr BP (Lewis, 1969; Forsyth, 1973). Such land-bridge islands are expected to approach equilibrium species number from a super-saturated state following isolation. Such a pattern is also evident in lizard species on land-bridge islands near Baja California (Wilcox, 1978) which are similar to the islands in Lake Erie in size, distance from the mainland, and time since isolation. Apparently equilibrium species numbers have not been reached in either case. On islands in Lake Erie, however, some recent colonization events apparently have taken place.

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