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UNIVERSITY/UNIVERSITÉ Carleton University, Ottawa, Ontario

DEGREE FOR WHICH THESIS WAS PRESENTED/
GRADE POUR LEQUEL CETTE THÈSE FUT PRÉSENTÉE Master of Science

YEAR THIS DEGREE CONFERRED/ANNÉE D'OBTENTION DE CE DEGRÉ 1976

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THE BIOLOGY AND CONSERVATION OF
EASTERN FOX SNAKES,
Elaphe vulpina gloydi CONANT

by

DONALD HENRY RIVARD, B.Sc.

A thesis submitted to the Faculty of
Graduate Studies in partial fulfilment
of the requirements for the degree of
Master of Science

Carleton University

Ottawa, Ontario

March 26, 1976

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ABSTRACT

One hundred and fifty-five observations of Elaphe vulpina gloydi Conant were made in 1972 and 1973 at 14 localities along the Lake St. Clair - Lake Erie waterway. The survival of this large ectothermic colubrid along the Lake Huron - Lake Erie waterway has probably resulted from the modifying effect of the Great Lakes on the climate of the Great Lakes Basin in seasonal, "temperate" North America. The association of eastern fox snakes with ecotone gradients, especially marsh and lake shorelines, probably facilitates general homeostasis including thermoregulation, water balance, and predator-prey relationships.

Increasing human efforts to preserve eastern fox snakes and their habitats have contributed to their survival as has the snakes' generalization from naturally-occurring environmental components to similar components introduced by humans. Eastern fox snakes and their habitats are threatened by the spatial and temporal coincidence of human and snake activity and the accelerating complexity of human activity.

We should conserve E. v. gloydi and its habitats as both are able to co-exist with humans while being beneficial and providing no demonstrable threat. Increased human efforts to conserve E. v. gloydi and its habitats and decreased human competition for the habitats are required.

ACKNOWLEDGEMENTS

I thank Dr. Donald A. Smith, Brian C. Hutchinson, Harold J. Parsons, Francis R. Cook, Dr. M. Brockett Fenton, members of the staff of the National and Historic Parks Branch, Department of Indian and Northern Affairs, Ottawa, and the numerous other individuals who contributed information to and assisted with the present study.

Information gathered in Canadian National Parks by myself, Dr. D.A. Smith, B.C. Hutchinson, and H.J. Parsons (Contract Nos. 72-30 and 73-23) and other workers is reported here with the kind permission of the National and Historic Parks Branch.

I thank Dyanne Bigras and Helen Dumych for preparing the manuscript computer record.

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INTRODUCTION

According to Underwood (1967) acquisition of diurnal behaviour and adaptation to higher working temperatures may have been critical to the origin and radiation of the ophidian infraorder Caenophidia. The two most diverse and widely distributed families of snakes in Canada, Colubridae and Natricidae (subfamilies Colubrinae and Natricinae of Goin and Goin 1971 and Porter 1972), are "advanced" caenophidians with a commitment to diurnality. Although the spread of the Colubridae in the temperate zone has been considerable, it is less extensive than that of the Natricidae. While natricids tend to occupy semiaquatic and aquatic biotopes that have few colubrid occupants, colubrids are more terrestrial, cursorial, and arboreal.

Elaphe Fitzinger, 1833 is a rather "conservative" genus in the Colubridae (Underwood 1967). More than 50 species and numerous subspecies have been included in Elaphe (Terent'ev and Chernov 1949, Taylor 1966, Peters and Orejas - Miranda 1970, Steward 1971, and Conant 1975). Synonyms include Callopeltis, Coluber, Elaphis, Natrix, Pantherophis, Pityophis, and Scotophis (Wright and Wright 1957). The genus is distributed over much of the subtropical and south and central temperate zones of the northern hemisphere (Figure 1). Biotopes occupied by Elaphe spp. include mountains, plains, forests, steppes, and the shorelines and floodplains of bodies of fresh water. Floodplains and open, unforested biotopes are preferred and biotopes altered by human activity, including agricultural and urban areas, are frequently

Figure 1. World distribution of the genus *Elaphe* Fitzinger, 1833.
After Pope 1935, Terent'ev and Chernov 1949, Taylor 1966,
Stebbins 1966, Peters and Orejas-Miranda 1970, Steward
1971, and Conant 1975.

inhabited. Prey is killed with or without constriction and includes mainly birds and mammals, especially rodents, but occasionally also reptiles, amphibians, fishes, and, rarely, insects. Most species are terrestrial and diurnal although some climb and/or swim and some are crepuscular and/or nocturnal.

Elaphe vulpina Baird and Girard, 1853 is unique in being the only member of the genus in the Western Hemisphere to be restricted to the temperate zone; it occurs further north than any other North American Elaphe.

Elaphe vulpina includes two similar, allopatric groups of populations (Figure 2) described by Conant (1940) as two subspecies, western fox snakes, E. v. vulpina and eastern fox snakes, E. v. gloydi. Because of the allopatry of the two groups of populations and the absence of any attempt to refute Conant's subspecific designations, and as a matter of convenience I will use these names without attaching any biological significance to them. Elaphe v. vulpina is generally restricted to the shorelines of the Mississippi River and its tributaries, and the sand dune region rimming portions of Lake Michigan where it inhabits woods, prairie, farmland, stream and river valleys and the margins of bodies of fresh water (Conant 1940, Hudson 1942, and Breckenridge 1944). Elaphe v. gloydi is restricted to specialized shoreline habitats along portions of the Lake Huron - Lake Erie waterway (Schmidt 1938, Conant 1940 and Smith 1957). Elaphe vulpina is thought to have extended its range eastward (Figure 2) along a post-Wisconsin

Figure 2. Distribution of *Elaphe vulpina vulpina* (after Conant 1975) and *Elaphe vulpina gloydi*.

glaciation prairie (steppe) peninsula (corridor) during a warm, dry (Xerothermic) period, approximately 4000 to 2000 B.C. subsequent invasion of the prairie peninsula by forest may have resulted in the species being separated into the two allopatric groups of populations, the eastern group, E. v. gloydi, surviving as a relict (Morse 1902, Schmidt 1938, Conant 1940, Smith 1957, and Bleakney 1958). Bleakney (1958) suggested that E. vulpina survived the Wisconsin glaciation in a Mexico-Texas refuge and subsequently moved north across the Great Plains and east across the prairie peninsula. However, the species' current distribution along the Mississippi River and Great Lakes waterway suggests that on the contrary it may have taken refuge in the Lower Mississippi area and subsequently extended its range northward along the Mississippi waterway, either reaching the eastern portion of the present range from the west across a prairie peninsula or by means of an early separation. The species may even have survived the Wisconsin glaciation in several southern refugia, the eastern and western forms being separated before or during glaciation.

The present project was designed to continue and intensify a field study of a population of E. v. gloydi carried out on a part-time basis by park staff at Point Pelee National Park, Essex County, Ontario since 1967, to synthesize the scattered published and unpublished data on this form, and to identify factors influencing the past, present, and future survival of this form in the park and elsewhere throughout its range in Ontario, Ohio, and Michigan (Figure 2).

STUDY AREA

Point Pelee National Park ($42^{\circ} 0' N$, $82^{\circ} 30' W$) is located in Mersea Township, Essex County, Ontario and comprises the southernmost 10 km of the Point Pelee sand spit, which extends 20 km southward into western Lake Erie and is the southernmost part of mainland Canada (Figure 3).

The park is bordered on the west, south, and east by sand beaches and Lake Erie (Figure 4). The total land area of the park is approximately 5 km^2 . The eastern and western sand spits and the northern park boundary (located along two east-west dikes and canals) encloses 10 km^2 of freshwater marsh.

The park is in the Niagara Section of the Deciduous Forest Region of Canada (Rowe 1972). Park biotopes considered are: sand beach, field, forest, parkland, and marsh (Figure 4). The majority of roadways, park and private buildings, and associated parking lots and grounds is located along the forested western sand spit. A more complete description of the park is found in the Point Pelee National Park Interpretive Plan (Anonymous 1972).

The privately-owned proximal portion of Point Pelee, extending 10 km north of the park (Figure 3), is bounded on the west by a continuous line of cottages to Seaclyffe and Leamington, Essex County and on the east by a shoreline housing development and Marentette's

Figure 3. Study area: Point Pelee, Essex County, Ontario.

Figure 4. Study area and biotopes in Point Pelee National Park.

Beach, a 1.5-km-long strip of undeveloped beach. The proximal area of the point includes Hillman's Marsh, a private waterfowl reserve, and numerous small farms; much of this farmland is reclaimed marsh and is maintained by a system of dikes, canals and pumphouses.

The entire study area (Figures 5 and 6) includes much of the Lake Huron - Lake Erie floodplain bounded by the 500-m contour line (Figure 5) and between $41^{\circ} 10'$ and $45^{\circ} 30'N$ latitude and between $84^{\circ} 0'$ and $79^{\circ} 30'W$ longitude. Most of the land in this study area is unforested and agricultural or urbanized; extensive forest areas are restricted to the north.

Figure 5. Study area: Michigan, Ohio, and Ontario. 500-m elevation contour line ——— 55-m depth contour line - - - - - Extensive Forest - [hatched box]

Figure 6. Study area, localities visited, and route taken in 1973 in Michigan, Ohio, and Ontario. Localities visited ●. Route — — —.

METHODS

During 100 days and 40 evenings from 17 May to 10 September 1972 I conducted field studies of reptiles and amphibians at Point Pelee. During 122 days and 55 evenings from 24 April to 5 September 1973 two assistants and I conducted field studies at the point. In addition, in 1973, we travelled for three weeks throughout much of the range of E. v. gloydi conducting field studies (Figure 6).

Searching and collecting were conducted on foot, by canoe, or by driving roads. All live specimens of E. v. gloydi found were captured by hand. Roadkills and ecdydic skins were examined. Locality, date, and time of day were recorded as well as snout-vent and vent-tail lengths and sex, determined by the methods of Cook (1965). All occurrences of injury were noted. The immediate location of each snake observed was described and any evidence of human activity noted. In localities such as dumps and beaches with extensive ground litter, a stevedore hook was employed to overturn litter.

In 1973, 100 1-yard-square (0.9 m^2) sheets of galvanized steel (28-gauge), referred to as "tins", were employed in the manner described by Weary (1969a) in the park to attract thigmothermic snakes. The tins, some on wooden frames and some on frames and floating on 10.2-cm-thick styrofoam sheets in the marsh, were placed in groups of four, eight, or 16 tins in a variety of biotopes and checked at two-day intervals during the early morning and late afternoon.

All snakes captured in the park were uniquely marked by a modification of the method of Weary (1969b). A #3 scalpel with a replaceable #11 blade and heated by a portable butane torch was employed (rather than a pyrographic needle or soldering pencil) to brand the subcaudal scales.

Information on E. v. gloydi was sought from and provided by local policemen; farmers; members of the staffs of Georgian Bay Islands and Point Pelee National Parks, Killbear, Six Mile Lake, Craigleith, Inverhuron, Point Farms, Pinery, Ipperwash, Holiday Beach, Wheatley, Rondeau, Port Bruce, and Long Point Provincial Parks in Ontario, and Crane Creek State Park, Ohio (Figure 6).

All literature known or suspected to refer to E. v. gloydi was searched to bring together relevant published information on this form. Moreover, requests for unpublished information on this subspecies were sent to every amateur or professional herpetologist or naturalist suspected of having records or data on E. v. gloydi in their field notes (Appendix I). Requests for specimen records and other data were also sent to museums and universities conducting biological or natural history research in Michigan, Ohio, and Ontario, and also to the National Museum of Natural History, Washington, D.C. In addition federal, provincial, and state wildlife agencies were asked to provide information on the current status of conservation legislation pertaining to E. v. gloydi within their respective jurisdictions.

RESULTS AND DISCUSSION

I Biology

A Distribution and Abundance

In 1972 and 1973 we made 155 observations of E. v. gloydi at 14 localities in Michigan, Ohio, and Ontario (Figure 7 and Appendix II). This is believed to be by far the largest number of observations ever made of this form in any single study. All our observations were made within several km of the Lake St. Clair - Lake Erie waterway shorelines. Our findings conform with the overall picture made up of pooling previous scattered observations of natural occurrences of eastern fox snakes. These show that the subspecies is restricted to the Lake Huron - Lake Erie waterway shoreline (especially sand spits) and some of its tributaries and islands (Figure 8 and APPENDIX III).

The survival of the large ectothermic colubrid E. v. gloydi along the waterway has probably resulted from the significant modifying effect of the lakes on the climate of the Great Lakes Basin, especially lake shorelines (Phillips and McCulloch 1972). The lakes act as vast reservoirs for the storage and subsequent exchange of heat energy with the atmosphere and the differential heat exchanges of land, air, and water result in a reduction in diel and seasonal temperature fluctuations, an increase in frost-free period and growing season, and almost no month-to-month variation in the amount of precipitation.

Figure 7. Distribution of observations of *Elaphe vulpina gloydi* made in 1972 and 1973 in Michigan, Ohio, and Ontario. Localities of observations are numbered; see Appendix II for details.

Figure 8. Counties and districts where *Elaphe vulpina gloydii* has been observed and number of observations in Michigan, New York, Ohio, and Ontario. ND - no numerical data. ? - not indicative of natural occurrence. See Appendix III for details.

The smaller range (Conant 1940) and smaller altitudinal distribution (Wright and Wright 1957) of E. v. gloydi as compared to E. v. vulpina may result from the proximity of the range of the former to larger bodies of water. Conant (1940) identified a west-to-east decrease in the dorsal body blotch count of E. vulpina; Smith (1956) identified a north-to-south decrease and suggested that the west-east cline was associated with the presence in the east of an anomalous climate characteristic of more southern latitudes.

Within the range of E. v. gloydi the observed abundance (Figure 8 and Appendix III) of snakes is greatest in the south suggesting that lower temperatures in the north limit their occurrence. Opinions concerning abundance are generally in agreement with the numerical data and further suggest that some populations have been dwindling recently (Table 1).

At Point Pelee National Park in 1972 and 1973 ten marked eastern fox snakes were recaptured from one to 25 days (mean = eight days) after their original captures and at or within several metres of their original capture sites. These and similar recapture data from previous park studies (Dutcher 1967, Pentudj 1968, Wyett and Burhoe 1969, Gemmell 1970, and F.R. Cook pers. comm.) provide little information on eastern fox snake activity.

TABLE 1. Abundance of *Elaphe vulpina gloydi* in Michigan, Ohio, and Ontario.

Abundance	Locality	County or District	State or Province	Authority
"in abundance"	Saginaw Bay	Huron	Michigan	Miles 1861
"quite common"	Saginaw Bay		Michigan	Ruthven 1909
"common"		Lucas to Erie	N. Ohio	Morse 1904
"abundant"		N.E. Lucas	N. Ohio	Conant 1938a
"fairly numerous"	Crane Creek	Ottawa	Ohio	E.J. Tramer pers. comm.
"common"	State Park		Ohio	Park staff pers. comm.
"quite abundant"	Lake Erie Islands		Ohio and Ontario	Langlois 1964
"not common"	Point Pelee	Essex	Ontario	Nash 1908
"common"	Lakes Erie and St. Clair and Georgian Bay		Ontario	Patch 1919
"common"	Georgian Bay		Ontario	Logier 1965
"fairly common"	Rondeau Provincial Park	Kent	Ontario	Lord 1956
"common"			Ontario	Park staff pers. comm.
"increasingly rare"	Wheatley Provincial Park	Kent	Ontario	Park staff pers. comm.
"increasingly rare"	Walpole Island	Kent	Ontario	Island residents pers. comm.
"increasingly rare"	Long Point Provincial Park	Norfolk	Ontario	Park staff pers. comm.
"increasingly rare"	Pinery Provincial Park	Lambton	Ontario	Park staff pers. comm.
"increasingly rare"	Ipperwash Provincial Park	Lambton	Ontario	Park staff pers. comm.
"increasingly rare"	Killbear Provincial Park	Parry Sound	Ontario	Park staff pers. comm.
"increasingly rare"	Georgian Bay		Ontario	V. Vriedenheim pers. comm.
"increasingly rare"	Lake Erie		S.W. Ontario	D.R. Fortner, and F.R. Cook pers. comm.

B Use of Biotopes.

In 1972 and 1973 observations of E. v. gloydi were made in all biotopes at Point Pelee National Park, most frequently in uncanopied areas of parkland, fields, and beaches and frequently (35% of all observations in 1972 and 53% in 1973) within 10 m of marsh shorelines; observations were rarely made in marsh or forest edges (Table 2 and Figure 9). In both years 39 (28%) of the total 137 observations were made at the park dump, an important park biotope for eastern fox snakes. One snake was found climbing 1 m up in a bush and four were observed swimming amongst and crawling over marsh vegetation. All other living snakes observed were sunning, crawling, or concealed in vegetation, litter, dumps, and hedgerows.

Observations made outside Point Pelee National Park in 1972 and 1973 (Figure 7 and Appendix II) were all in fields and beaches near marsh shorelines; living snakes were crawling, sunning, or concealed. The pattern of biotope use observed in 1972 and 1973 is essentially the same as observed by other workers (Figure 8 and Appendix III).

The apparent preference of eastern fox snakes for open and shoreline biotopes, their heliothermy, and general avoidance of cooler forest and water suggests that low temperature may restrict their occurrence. In 1972 and 1973 at Point Pelee smaller eastern fox snakes (total length $\leq$ 1000 mm) were found more often away from water and under cover than larger snakes; Adams and Clark (1958) made similar observations of the subspecies in Norfolk County, Ontario. Smaller snakes with more rapid rates of heat exchange may prefer slower thigmothermy to more rapid heliothermy and may be more prone to avoid the heat sink of "temperate" bodies of water. Larger snakes may be more

Figure 9. Biotopes and sites where Elaphe vulpina gloydi was observed during 1972 and 1973 and number of observations per site in Point Pelee National Park. In both years 39 (28%) of the 137 observations were made at the park dump, an important park biotope for eastern fox snakes.

TABLE 2. Percentage of observations of *Elaphe vulpina gloydi* and percentage of single man searches made in different biotopes in 1972 and 1973 in Point Pelee National Park.

		Biotopes				
		Field	Beach	Parkland	Forest	Marsh
1972	% of single man searches	21%	21%	5%	22%	31%
						total searches (100%) 420
	% of observations of <i>E. v. gloydi</i>	66%	14%	8%	9%	3%
						total No. of observations (100%) 64
	% of single man searches on marsh shorelines	11%	9%	no marsh shoreline	11%	19%
						total searches (100%) 420
	% of observations of <i>E. v. gloydi</i> made within 10 m of marsh shoreline	22%	8%	no marsh shoreline	3%	2%
						total No. of observations (100%) 64
1973	% of single man searches	26%	19%	7%	22%	26%
						total searches (100%) 1505
	% of observations of <i>E. v. gloydi</i>	79%	7%	4%	1%	5%
						total No. of observations (100%) 73
	% of single man searches on marsh shorelines	13%	8%	no marsh shoreline	10%	14%
						total searches (100%) 1505
	% of observations of <i>E. v. gloydi</i> made within 10 m of marsh shoreline	47%	1%	no marsh shoreline	0%	5%
						total No. of observations (100%) 73

visible to herpetologists in the open and smaller snakes may prefer concealment from predators; McBride (1962) provided data suggesting that larger eastern fox snakes are less likely to actively defend themselves than smaller ones.

C Prey

Eastern fox snakes generally take avian and mammalian prey although ectothermic vertebrates and invertebrates may be occasionally consumed (Table 3); plant material has been found only in snakes containing rodents suggesting that plant material is consumed by the rodents prior to their ingestion by snakes. Endothermic prey may be heat sources for snakes ingesting them while ectotherms (except reptiles) are probably heat sinks.

Observations of eastern fox snakes feeding in trees (D.A. Smith pers. comm.) indicate that E. v. gloydi climbs in pursuit of avian prey (Table 3). Snakes found preying on birds and eggs are killed by humans (D.A. Smith pers. comm. and A.M. White pers. comm.) although Stokes (1953?) found that this subspecies was responsible for only 10 of a total of 1103 failures of Ring-necked Pheasant nests in 1949 and 1950 on Pelee Island, Essex County, Ontario. Logier (1939) regarded E. v. gloydi as one of Ontario's most economically valuable snakes because of its predation on mice and rats.

TABLE 3. Diet of Elaphe vulpina gloydi in Ontario, Ohio, and Michigan.

Prey	Authority	Locality
Duck eggs	This study	Monroe Co., Michigan
Immature rabbits	Ruthven (1912)	Huron Co., Michigan
<u>Microtus</u> sp., <u>Peromyscus</u> sp., fledgling birds (probably Red-winged Blackbirds), and quail and chicken eggs	Conant (1938a)	Ohio
Song Sparrow eggs and nestling Starlings	Langlois (1964)	Lake Erie islands
Meadow voles (<u>Microtus pennsylvanicus</u>), house mice (<u>Mus musculus</u>), and duck eggs	A.M. White pers. comm.	Ottawa Co., Ohio
Immature meadow voles (<u>Microtus pennsylvanicus</u>)	This study	Kent Co., Ontario
Starlings	McBride (1962)	Kent Co., Ontario
Pheasant eggs and young	Langlois (1964)	Essex Co., Ontario
Pheasant and Wood Duck eggs	Stokes (1953?)	Essex Co., Ontario
Deer mice (<u>Peromyscus maniculatus</u>) and Brown-headed Cowbirds	Logier (1925)	Essex Co., Ontario
Meadow voles, pheasant eggs, and acorns	Wyett and Burhoe (1969)	Essex Co., Ontario
<u>Peromyscus</u> sp. and unidentified plant material	F.R. Cook pers. comm.	Essex Co., Ontario
Earthworms	Snyder and Logier (1931)	Norfolk Co., Ontario
Chipping Sparrow eggs and young, and nearly fledged Purple Martins	D.A. Smith pers. comm.	Norfolk Co., Ontario
Blue-spotted salamander (<u>Ambystoma laterale</u>)	Logier (1939)	Muskoka Dist., Ontario
Eastern chipmunk (<u>Tamias striatus</u>)	G.E. Gemmell pers. comm.	Muskoka Dist., Ontario

The association of E. v. gloydi with highly productive marshes (De Vos and Mosby 1963) is probably due in part to the ready availability and variety of prey species. The preference of this subspecies for ecotones (shorelines, forest borders, hedgerows, dumps, etc.) probably facilitates pursuit and ambush of prey as well as concealment and escape from predators.

D Reproduction

At Point Pelee National Park in 1972 and 1973, adult snakes were more frequently observed than juveniles (Table 4). The size, possible thigmothermy, frequent concealment, and susceptibility to predation, as previously discussed, may make juvenile snakes difficult to observe; they may be locally abundant only soon after hatching.

The sex ratio (males to females) of all eastern fox snakes observed in 1972 and 1973 does not vary significantly, as determined by chi-square analysis, from 1:1, although the samples from outside Point Pelee National Park are not large enough to support this inference (Table 4).

A captive pair of E. v. gloydi was observed mating on 23 June 1972 at Point Pelee National Park. Nine gravid females were observed between 25 June and 14 July, 1972 at the park dump and at hedgerows and a haystack in the fields (Figure 4), and seven gravid females were observed at the dump between 4 and 16 July 1973 (Table 5). On 24 July

TABLE 4. Age and sex of Elaphe vulpina gloydi observed in 1972 and 1973 in Essex and Kent Counties, Ontario.

	No. of Adults		No. of Unsexed Juveniles	No. where Age and Sex Undetermined		Total No. Examined (100%)	Locality
	Males	Females					
1972	18(28%)	26(41%)	6 (9%)	14 (22%)	64		Point Pelee National Park, Essex Co.
1973	25(34%)	23(32%)	8 (11%)	17 (23%)	73		Point Pelee National Park, Essex Co.
1972 } 1973 }	43(31%)	49(36%)	14 (10%)	31 (23%)	137		Point Pelee National Park, Essex Co.
1972 } 1973 }	6(67%)	1(11%)	-	2 (22%)	9		Essex Co. (exclusive of Point Pelee National Park.
1972 } 1973 }	6(67%)	2(22%)	-	1 (11%)	9		Kent Co.
1972 } 1973 }	12(67%)	3(16.5%)	-	3 (16.5%)	18		Essex Co. (exclusive of Point Pelee National Park) and Kent Co.
1972 } 1973 }	55(35%)	52(34%)	14 (9%)	34 (22%)	155		Essex and Kent Counties

1972 a captive female laid 18 eggs (adhering in a mass) and on 25 July a second captive laid 19 eggs (adhering in a mass). While we failed to locate any natural egg depositions, Patch (1919) found egg masses under dead wood on the beaches of Point Pelee; Logier (1939) and Evans and Roecker (1951) listed decaying logs, manure heaps, and sawdust piles as egg-laying sites. Eggs may be incubated and humidified by the decaying vegetation characteristic of sites where both eggs and gravid females are known to occur.

The reproductive data on eastern fox snakes observed at Point Pelee National Park in 1972 and 1973 are typical of the subspecies (Patch 1919, Conant 1938a, Logier 1939, Mattlin 1948, Evans and Roecker 1951, Triplehorn 1955, Wright and Wright 1957, Langlois 1964, Wyett and Burhoe 1969, and F.R. Cook pers. comm.). Reproductive activity occurred coincidentally with the June - July activity peak subsequently discussed, indicating that reproduction and overall activity are temporally related.

E Diel and Seasonal Activity

In 1972 and 1973 at Point Pelee National Park, all but two living eastern fox snakes were found during daylight hours indicating that the subspecies is primarily diurnal. However, as two snakes were found on 6 June 1972 crossing roads after dark, eastern fox snakes must be occasionally crepuscular and/or nocturnal. In 1971 F.D. Ross (F.R. Cook pers. comm.) found a snake active in the park after dark.

TABLE 5. Capture date and length of gravid female *Elaphe vulpina gloydi* in 1972 and 1973 in Point Pelee National Park.

Capture Date	Length (mm)	
	Snout-vent	Total
25 June 1972	1168	-
25 June 1972	1042	1189
25 June 1972	1092	1252
6 July 1972	940	1066
9 and 10 July 1972	1200	1384
13 July, 1972	1219	1490
14 July 1972	1080	1229
18 July 1972	1067	1228
4 July 1973	1205	1380
5 July 1973	840	962
6 July 1973	1150	1310
16 July 1973	985	1125
16 July 1973	1105	1270
16 July 1973	925	1057
16 July 1973	968	1110

In both years at the park the observed activity of eastern fox snakes increased from May to June and July and decreased from July to August and September (Table 6); in 1973 the onset of warmer summer weather was later than in 1972 and eastern fox snakes displayed a delayed early summer activity peak. Our observations of E. v. gloydi in Michigan, Ohio and Ontario outside the Park were made in June through September (Appendix II). Although a few snakes were found in April and October, most other workers in Michigan, Ohio, and Ontario observed E. v. gloydi between May and September and most often in May through July (Conant 1938b, Mattlin 1948, Triplehorn 1955, Amorose 1958, Langlois 1964, A.M. White pers. comm., E.J. Tramer pers. comm., Logier 1925, Snyder and Logier 1931, D.A. Smith pers. comm., Evans and Roecker 1951, Adams and Clark 1958, McBride 1961, Dutcher 1967, Pentudi 1968, Wyett and Burhoe 1969, Gemmell 1970, F.R. Cook pers. comm., Campbell 1971a, Gemmell 1974, and G.E. Gemmell pers. comm.). In agreement with Bleakney (1958) cold winters and the poikilothermy of eastern fox snakes necessitate a hibernation period of at least five months.

Conant (1938b) observed a May activity peak for E. v. gloydi in Lucas County, Ohio; this indicates that the earlier spring in Lucas County, as compared to Point Pelee National Park, results in an earlier activity peak for southern populations. Conant observed a lesser October activity peak in Lucas County and F.D. Ross (F.R. Cook pers. comm.) observed a similar lesser September activity peak at Point Pelee National Park. These findings suggest that the period of increased fall activity is delayed in the south.

TABLE 6. Distribution of observations of Elaphe vulpina gloydi by month
in 1972 and 1973 in Point Pelee National Park.

	May	June	July	August	September	Total No. examined (100)%
1972	3 (4.5%)	33 (51.5%)	24 (38%)	2 (3%)	2 (3%)	64
1973	5 (7%)	28 (38%)	37 (51%)	3 (4%)	-	73
1972 } 1973 }	8 (6%)	61 (44.5%)	61 (44.5%)	5 (3.5%)	2 (1.5%)	137

Conant (1938b) associated the spring activity peak of E. v. gloydi with basking after hibernation, a lack of vegetation for concealment, mating activity, and a herpetologists' spring activity peak, while he attributed the fall activity peak with aggregation at dens; he associated the summer reduction in observed activity with a possible tendency toward nocturnal activity. Increased foraging for prey soon after and soon before hibernation may account for the spring and fall activity peaks (F.R. Cook pers. comm.). Doubtless these various factors influence the activity of the Point Pelee National Park population of E. v. gloydi although eastern fox snake dens have not been found in the park; the sand-biased, low-relief land area of the park does not appear to be well suited to the establishment of sizeable snake dens.

The correlation of most observed eastern fox snake activity in Michigan, Ohio, and Ontario with the daylight hours of May through September and the earlier spring and later fall activity peaks of Ohio populations (Conant 1938b), as compared to the Point Pelee National Park population further north, suggest that low temperature restricts activity. The reduction in observed daylight activity in late July and August suggest that high temperature also restricts eastern fox snake activity. Rarely observed nocturnal activity in June suggests a possible shift in diel activity in response to higher temperatures.

II Conservation

A Successes

1. Snakes

References to human influence on eastern fox snakes date from the time of Miles (1861) to the present whereas discussions of conservation are more recent. Lately more people in Canada have developed enlightened attitudes toward snakes (Froom 1967). Point Pelee and Georgian Bay Islands National Parks, Killbear, Pinery, and Rondeau Provincial Parks, Ontario, and Crane Creek State Park, Ohio (Figures 6 and 7) all use resident eastern fox snake populations in their interpretive programs. In 1972 and 1973 we found that most people familiar with E. v. gloydi referred to these snakes generally as "fox snakes" or "eastern fox snakes" and only rarely as "copperheads" indicating that the literature is familiar to both professional conservationists and the public; the name "fox snake" has apparently been used only by herpetologists and readers of their works (Conant 1940).

Elaphe v. gloydi is protected by law in Ohio and in the National Parks in Ontario. The subspecies may be legally protected in the future in the U.S.A. and Ontario if demonstrably endangered (E.B. Baysinger pers. comm. and J.A. Shannon pers comm.). Legislation protecting E. v. gloydi throughout its range could, like the National Parks Act, provide for the issue of permits to study or collect snakes for research projects.

2. Habitat Conservation.

Although mortality of Canadian snakes due to collecting, direct killing because of human fear of snakes, and road traffic is a factor in the apparent attrition of some species, the destruction of their habitats is probably the most important factor (Cook 1970). Much of the marsh and shoreline (especially beach) habitat of E. v. gloydi throughout its range has been conserved to some degree or other for wildlife and/or outdoor recreation. There is a growing awareness of the value of marshes as highly productive wildlife areas and important ecological components of the terrestrial and aquatic environments (De Vos and Mosby 1963, and Skrypek 1973) and marsh drainage in southwestern Ontario has probably proceeded almost as far as it is possible to proceed (C.E. Goodwin pers. comm). There is an increasing effort to identify and conserve natural ecosystems (Cook 1970, Sheard and Blood 1973, and McLaren and Peterson 1975) including those of which E. v. gloydi is an integral part.

3. Habitat Change.

As a Xerothermic relict of the post-Wisconsin prairie peninsula, E. v. gloydi may have been doomed to extinction by climatic change and encroaching forests (Smith 1957); human forest-clearing probably reversed this trend. Most of the land in the Niagara Forest Section of Ontario, including much of the southern part of the province, is now densely settled; the natural forest vegetation has been mostly reduced to farm woodlots, hedgerows, and remnant stands on soils too poor to farm (Rowe 1972). Within this century there has been an appreciable reduction in the species diversity of the herpetofauna of southern

Ontario (Cook 1970) and especially of Point Pelee; ten species of amphibians and reptiles previously reported at the Point (Stejneger 1895, Patch 1919, and Logier 1925) have not been positively located there in recent years (Rivard and Smith 1972). Most of the missing species are associated with beach, forest, or upland biotopes, and five snakes (Sistrurus c. catenatus, Coluber constrictor flaviventris, Crotalus h. horridus, Lampropeltis dolia triangulum, and Elaphe o. obsoleta) are large predators on endotherms. The increased demand for agricultural land has resulted in much of the original forest of Point Pelee being cleared, the remaining stands being largely occupied by human dwellings and roadways. Elaphe v. gloydi, preferring open biotopes, may have competitively excluded the other five large snake species. Possible competitive exclusion has been observed at Rondeau Provincial Park, Kent County, Ontario (Campbell 1971b) and in northern Ohio (Conant 1938a). Moreover E. v. vulpina persists in the farmed prairies of central Illinois from which many other snake species have been almost or entirely exterminated (Smith 1961).

As eastern fox snakes were regularly found at or near dikes, canals, drainage ditches, and the Point Pelee National Park marsh boardwalk in 1972 and 1973 in Michigan, Ohio, and Ontario (Figure 7 and Appendix II) it seems likely that the presence of such constructions has increased the extent of shorelines occupied by snakes. In both years human trash (discarded boards, asphalt, masonry, brush, household garbage, and machines including cars) was found at all localities where E. v. gloydi was observed (Figure 7 and Appendix II), and eastern fox snakes

were regularly found on, in, or under human refuse indicating that trash is replacing natural ground cover. Rodent populations are unusually dense in garbage dumps (Courtney and Fenton in press). At Point Pelee National Park snakes were observed at anti-erosion works and hedgerows, again indicating that human-made standing cover is used.

Table 3 showed that eastern fox snakes prey on species of birds and mammals introduced to North America as well as on naturally occurring species.

Elaphe v. gloydi has persisted with environmental alteration (including changes in associated flora and amphibian, reptile, avian, and mammalian faunas) by generalizing from naturally occurring environmental components (prairie, native endotherms, and natural ecotones) to similar but different components introduced to North America by humans (farm land, exotic endotherms, and human-made ecotones).

B Threats

1. Snakes

In 1973 two eastern fox snakes we found at the Point Pelee National Park dump (Figures 4 and 10) were more or less covered with tar (from dumped asphalt road remains), although still living and active. Meeks (1968) found DDT residues in three eastern fox snakes up to 12 months after application of DDT to a 1.5-ha marsh in Ohio; he stated that the current use of persistent chemicals to control nuisance and vector insects poses a threat to the wetland environment of the U.S.A. that

Figure 10. Park dump beside drainage ditch and on field-marsh ecotone in Point Pelee National Park. Elaphe vulpina gloydi was observed at this locality more often (39 observations) than at any other site visited in 1972 and 1973 in Michigan, Ohio, and Ontario.

cannot be fully assessed with existing knowledge of wetland-insecticide dynamics. Elaphe v. gloydi, being a secondary consumer, is subject to pesticide concentration (Meeks 1968); further research dealing with the influences of pesticide and other forms of pollution on E. v. gloydi and its habitats is indicated.

In 1972 at Point Pelee National Park we found two dead eastern fox snakes lying on a recently rearranged pile of lumber; they had been slit along the venter and left apparently uneaten, suggesting that a human, rather than another predator, had killed them. Many of the people we interviewed in 1972 and 1973 in Ohio and Ontario were aware of incidents involving eastern fox snakes being deliberately killed by humans. A resident of Walpole Island, Kent County, Ontario had shot five snakes that had inhabited his haystack because his wife was afraid of them. Eastern fox snakes have often been deliberately killed in the erroneous belief that they are poisonous or because of their predation on birds (Miles 1861, Conant 1938a and 1965, A.M. White pers. comm., Logier 1939, D.A. Smith pers. comm., Logier 1958, McBride 1962, Gemmell 1970, Cook 1970, and F.D. Ross - F.R. Cook pers. comm).

The low relief of prairies and floodplains allows the construction of extensive, interconnecting roads (Wagner 1971). The occurrence of E. v. gloydi in floodplain areas and the records (Table 7) of substantial numbers of roadkills and crossings observed over many years in Michigan, Ohio, and Ontario suggest that road traffic has been an important cause (perhaps a major one) of mortality for this

TABLE 7. Observations of *Elaphe vulpina gloydi* on roadways in Ontario, Michigan, and Ohio.

Total No.	No. of Roadkills	Authority	Location
?	?	Dutcher (1967)	Point Pelee National Park, Essex Co., Ont.
?	1	Pentudi (1968)	Point Pelee National Park, Essex Co., Ont.
?	2	Wyett and Burhoe (1969)	Point Pelee National Park, Essex Co., Ont.
?	6	Gemmill (1970)	Point Pelee National Park, Essex Co., Ont.
?	11	F.R. Cook pers. comm. (observed in 1971)	Point Pelee National Park, Essex Co., Ont.
7	1	This study (observed in 1972)	Point Pelee National Park, Essex Co., Ont.
7	4	This study (observed in 1973)	Point Pelee National Park, Essex Co., Ont.
1	0	F.R. Cook pers. comm. unnumbered	Point Pelee National Park, Essex Co., Ont.
1	1	NMNS* specimen (taken in 1971)	Hillman's Creek, Essex Co., Ont.
?	?	NMNS* 14826 (taken in 1971)	Pelee Island, Essex Co., Ont.
8	8	Campbell (1971b)	Rondeau Provincial Park, Kent Co., Ont.
		This study (observed in 1973)	Essex and Kent Counties, Ont.
			Locality Nos. 2, 3, 4, 5, 6, 7, and 14 of Table 1 and Figure 4.
1	1	ROM* 2675 (taken in 1932)	St. Williams, Norfolk Co., Ont.
1	1	NMNS* 13817 (taken in 1971)	Long Point Provincial Park, Norfolk Co., Ont.
6	6	G.E. Gemmill pers. comm. (observed in 1974)	Highway 501, Muskoka Dist., Ont.
1	1	This study (observed in 1973)	Monroe Co., Michigan - Locality No. 11 of Table 1 and Figure 4.
?	?	Conant (1938a)	Northern Ohio
2	0	Amorose (1958)	Kelley's Island, Erie Co., Ohio.
?	?	A.M. White pers. comm.	Ottawa Co., Ohio.

* ROM - Royal Ontario Museum, Toronto, Ontario.

NMNS - National Museum of Natural Sciences, Ottawa, Ontario.

subspecies. The records of snakes on roads on Pelee Island, Essex County, Ontario (NMNS 14826) and Kelley's Island, Erie Co., Ohio (Amorose 1958) are noteworthy in that roads and ferries connect the larger lake Erie islands to the Ohio and Ontario mainlands.

In 1972 and 1973 at Point Pelee National Park most live eastern fox snakes encountered on roads appeared to be crossing; this suggests that roads and traffic are hazardous obstacles to this subspecies. The unnumbered NMNS specimen taken near Hillman's Creek in 1971 (F.R. Cook pers. comm.) was found sunning beside a road; thus roadways may be used as basking sites in addition to being obstructions to movement.

Human interest in E. v. gloydi has resulted in individual snakes being permanently removed from natural populations or relocated in different populations (Logier and Toner 1961, Pentudi 1968, D.R. Fortner - F.R. Cook pers. comm., Campbell 1969, and Cook 1970). Collecting of rare Canadian amphibians and reptiles such as E. v. gloydi is usually best left to professionals in cases where collected specimens contribute substantially to a specific research program, and the effect on the population is considered (Cook 1970).

2. Habitats

Many of the marsh areas where eastern fox snakes were observed in 1972 and 1973 in Michigan, Ohio, and Ontario were maintained by canals

and dikes and most of these constructions were being built or repaired necessitating the removal or burying of the surrounding vegetation and litter (Figures 11 and 12). While some marshes and pieces of marsh throughout the range of E. v. gloydi have been saved from being drained or filled, most of these are maintained for recreation and conservation by canals, dikes, water-level control, weed-cutting, burning, planting of aquatics, blasting, and application of herbicides without much regard for the dynamic nature of marsh ecosystems (Day 1934 and Bryant 1965).

Beaches within the range of E. v. gloydi are managed and exploited by humans to much the same extent as marshes. Erosion, sedimentation, and flooding of the east beach of Point Pelee National Park in 1973 (Figure 13) resulted in an appreciable reduction in observations of E. v. gloydi (and other squamates) as compared to 1967 through 1972 (Dutcher 1967, Pentudi 1968, Wyett and Burhoe 1969, Gemmell 1970, F.R. Cook pers. comm., and this study). In 1972 and 1973, erosion and flood control works were located on much of the beach in the southern part of the Park, along the shorelines northwest and northeast of the Park, and on northeastern Pelee Island. Erosion, sedimentation, and flooding result from efforts to control dynamic water levels and shorelines for shore properties, navigation, power, recreation, domestic water supply, wildlife, and consumptive uses (Figure 14) (Terasmae 1969 and Anon 1973).

Dumping of trash has resulted in the partial filling of most shorelines and marsh edges where E. v. gloydi was observed in 1972 and

Figure 11. Northwest park dike and canal in 1973 in Point Pelee National Park. Reconstruction necessitated by excessively high spring water levels in Lake Erie and resultant park flooding and high water levels in the marsh.

Figure 12. Marsh boardwalk and associated dredged channel in 1973 in Point Pelee National Park. Observation tower, parking lot, and canoe, boat, and bicycle rental facility can be seen in the foreground.

Figure 13. Sand covering east beach ground litter and vegetation and filling marsh in 1973 in Point Pelee National Park. This resulted from excessively high spring water levels in Lake Erie and flooding, erosion, and sedimentation.

Figure 14. Recreational use of beach with picnic and lifesaving facilities in 1973 in Point Pelee National Park.

1973 in Michigan, Ohio, and Ontario (Figures 7 and 15). Low-lying areas, especially wetlands, are rapidly being filled in in North America as garbage production continues to increase (Wagner 1971).

Succession is resulting in a reduction of the fields at Point Pelee National Park as more private farm or cottage properties are purchased and left fallow; as eastern fox snakes were most frequently observed in these fields (Table 2 and Figure 9) the continued maintenance of fields may be essential to the survival of the snake population.

In 1972 and 1973 we failed to observe E. v. gloydi in the reclaimed-marsh farmland between the Park and Hillman's Marsh (Figures 3, 11 and 16) despite extensive searching; marsh draining or filling probably had eradicated local populations of eastern fox snakes. Sheard and Blood (1973) recommended the establishment around national parks of buffer zones in which land use and management practices are designed to reduce direct impact on the parks' biota.

3. Organization

Efforts to conserve and manage wildlife areas within the range of E. v. gloydi are somewhat piecemeal and unco-ordinated. The subspecies occurs in two nations, one province, two states, and numerous counties, districts, municipalities, etc. (Figure 8). Conservation areas containing eastern fox snakes, are more or less isolated by

Figure 15. Trash dumping at marsh in 1973 in Holiday Beach Provincial Park, Essex County, Ontario.

Figure 16. Farmland located in reclaimed marsh north of Point Pelee National Park in 1973. In 1972 and 1973 Elaphe vulpina gloydi was not observed in farmland except in localities adjacent to water other than drainage canals.

intervening agricultural, recreational, and urban areas and responsibility for conservation efforts lies with a number of governmental agencies at various levels and private individuals or organizations (Day 1934, Bryant 1965, and McLaren and Peterson 1975).

4. Spatial and Temporal Coincidence

At Point Pelee National Park there is an appreciable coincidence of seasonal activity of humans and of eastern fox snakes. Human visitation and occupation, generally associated with outdoor recreation, is greatest during the day, on weekends, and during May, June, July, and August (Anon 1972) and Table 6 showed that eastern fox snakes are most apparent during the daylight hours of the same months, especially June. Agricultural activity in the park is similarly greatest during the warmer months. In all portions of the range of E. v. gloydi visited in June, July, and August of 1972 and 1973 (Figures 6 and 7) and in May, June, July, and August of 1974 (eastern Georgian Bay, Muskoka District, Ontario) human activity associated with recreation, industry, agriculture, and urbanization was very apparent suggesting that human and snake activity are and have probably always been greatest during warmer weather.

Throughout its range the shoreline occurrence of E. v. gloydi and the similar human preference for shorelines (Doxiadis 1966) has resulted in a considerable spatial as well as temporal overlap in occupation and activity. Doxiadis (1966) described the Great Lakes

region as the second largest and fastest growing centre of urbanization in North America and the primary industrial centre; it is also important agriculturally. He defined megalopolis centred on Detroit (approximately 48 km northwest of Point Pelee National Park), developing on the Great Lakes flood plain; the tentative boundaries of this urban "bloom" may, at their greatest extent, include most of the flood plain range of E. v. gloydi. Such an event would doubtless exterminate many or all existing populations of eastern fox snakes. Human population density is greatest in the south (the Lake St. Clair - Lake Erie flood plain) where populations of E. v. gloydi are apparently most abundant and sizeable (Figure 8 and Appendix III).

The spatial and temporal coincidence of human and eastern fox snake populations result from a variety of factors including the marked seasonality of North America's climate and the anomalous local climate, extensive low-relief topography, and water reservoir of the Great Lakes Basin (Bleakney 1958, Doxiadis 1966, and Phillips and McCulloch 1972).

5. Accelerating human activity.

Ontario is one of the fastest growing areas in Canada in terms of human population and income and, as it is still relatively underdeveloped compared to the American side of the Great Lakes, it will continue to display dynamic growth until the large existing potentials are fully exploited (Doxiadis 1966). Substantially more observations in of eastern fox snakes have been made in Ontario than in Ohio or Michigan

(Figure 8 and Appendix III) and a number of Ontario populations of E. v. gloydi are now considered to be dwindling (Table 1). This suggesting that Ohio and Michigan populations may have been adversely affected by the considerable agricultural and urban development that has already taken place while Ontario populations are now being similarly affected by current, parallel development in the province. Human recreational use of Point Pelee National Park (Figure 14) has increased greatly in recent years and will probably continue to increase (Anon 1972). Human activity within the range of E. v. gloydi is thus not only considerable but accelerating, as is the concomitant competition with eastern fox snakes.

III SUMMARY

A Biology

The occurrence and activity of eastern fox snakes is probably restricted by low temperatures. Within their range the observed abundance of eastern fox snakes is greatest in the south. Snakes prefer open and shoreline biotopes, avoid cooler forest and water, and are heliothermic. Most observed snake activity, including reproductive activity, occurs during the daylight hours of May through September; the annual activity period of Ohio populations is apparently longer than that of Ontario populations.

High temperature may restrict the occurrence and activity of eastern fox snakes. Observed daylight activity is reduced in late July and August and nocturnal activity has been observed in June. Elaphe vulpina is unique in being the only member of the genus in the western hemisphere to be restricted to the "temperate" zone and occurs further north than any other North American Elaphe.

The survival of the large ectothermic colubrid E. v. gloydi along the Lake Huron - Lake Erie waterway shoreline has probably resulted from the significant modifying effect of the Great Lakes on the climate of the Great Lakes Basin, especially lake shorelines, in markedly seasonal, "temperate" North America.

The preference of eastern fox snakes for ecotones, especially lake and marsh shorelines, probably facilitates general homeostasis. In addition to providing gradients for thermoregulation and water balance

ecotones probably facilitate pursuit and ambush of prey and concealment and escape from predators; marshes are highly productive (De Vos and Mosby 1963) and prey are varied and abundant along their shorelines.

B Conservation

Ever-increasing human efforts to preserve eastern fox snake populations and associated biotopes (especially beaches and marshes) for recreation and conservation have contributed to the survival of the subspecies as has its generalization from naturally-occurring environmental components (prairie, native endotherms, and natural ecotones) to similar but different components introduced to North America by humans (farm land, exotic endotherms, and human-made ecotones).

Eastern fox snake populations and associated biotopes are threatened by the spatial and temporal coincidence of human and snake activity and the increasing and accelerating complexity of modern human activity. Snakes accumulate petrochemicals, are killed by humans and road traffic, and are removed by humans from populations. Marsh and shoreline (especially beach) biotopes are maintained in an artificial, unstable manner, filled by trash dumping, and drained or filled for agriculture. Conservation areas containing eastern fox snakes are more or less isolated by intervening agricultural, recreational, and urban areas and responsibility for conservation efforts lie with a number of governmental agencies at various levels as well as private individuals and organizations.

IV CONCLUSIONS

Whereas terrestrial vertebrate predators in general, and especially larger snakes, raptors, and Carnivora, are becoming increasingly rare in both natural and human-altered biotopes in eastern North America, eastern fox snakes, although threatened, still exist as components of both biotope types. We should conserve E. v. gloydi and the biotopes it inhabits because both already co-exist with us while contributing to our well-being and providing no demonstrable threat to us or our activities. Increased human efforts to conserve eastern fox snakes and their habitats and decreased human competition for the habitats are required.

The similarity of E. v. gloydi and E. v. vulpina with respect to biology and conservation considerations (including human influences) suggests that this study could be profitably extended to include the entire species.

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APPENDIX II. Summary of Observations of *Elaphe vulpina gloydii* made for this study in 1972 and 1973 in Michigan, Ohio, and Ontario.

Locality No.	Date	No. of Observations	Location
1	25 May - 5 Sept. 1972	64	Point Pelee National Park, Essex Co., Ont.
1	9 May - 18 Aug. 73	71	Point Pelee National Park, Essex Co., Ont.
2	2 June 72	2	Hillman's Marsh, Essex Co., Ont.
2	15 June 73	1	Hillman's Marsh, Essex Co., Ont.
3	19 June 73	1	Highway 3, Kent Co., 12 km N.E. of Wheatley, Ont.
4	19 June 73	1	Highway 3, Kent Co., 8 km W. of Cedar Springs, Ont.
5	19 June 73	1	Highway 57, Kent Co., 1 km S.W. of Morpeth, Ont.
6	7 July 73	1	Highway 3, Kent Co., 8 km N.E. of Wheatley, Ont.
7	7 July 73	1	Highway 3, Kent Co., 1 km W. of Cedar Springs, Ont.
2	7 July 73	1	Mersea Twp, Road No. 2, Essex Co., adjacent to Hillman's Marsh, Ont.
8	9 July 73	2	Bradley's Marsh, Kent County, Ont.
9	16 July 73	2	Bondy's Canals, Essex Co., 8 km S. of La Salle, Ont.
10	16 July 73	1	Cedar Creek, Essex Co., 0.5 km S. of Highway 18, Ont.
11	19 July 73	1	Mouth of Stony Creek, Monroe Co., Mich.
12	19 July 73	1	Crane Creek State Park, Ottawa Co., Ohio.
13	31 Aug. 73	2	Holiday Beach Provincial Park, Essex Co., Ont.
2	31 Aug. 73	1	Essex Co. Road 33, adjacent to Hillman's Marsh, Ont.
14	3 Sept. 73	1	Highway 3, Kent Co., 1 km N.E. of Morpeth, Ont.

APPENDIX III. Summary of Literature and Sight Records of Elaphe
vulpina gloydi in Michigan, New York, Ohio, and Ontario.
 * Indicates a questionable record.

State or Province	County or District	Authority	No. of specimens, observations and/or shed skins
Michigan	Monroe	This study 1973	1
		Ruthven 1912	
		Conant 1940	1
		M.M. Hensley pers. comm.	
		C.F. Walker pers. comm.	2
	Wayne	Baird and Girard 1853	1
		Ruthven 1909 and 1912	
		Conant 1940	3
		M.M. Hensley pers. comm.	
		R.B. Bury pers. comm.	1
		C.F. Walker pers. comm.	2
	Macomb	M.M. Hensley pers. comm.	
		C.F. Walker pers. comm.	1
	St. Clair	Ruthven 1909 and 1912	
		Conant 1940	2
		M.M. Hensley pers. comm.	
		C.F. Walker pers. comm.	2
	Sanilac	M.M. Hensley pers. comm.	
	Huron	Ruthven 1909 and 1912	
		Conant 1940	1
		M.M. Hensley pers. comm.	
		C.F. Walker pers. comm.	9
	Saginaw	M.M. Hensley pers. comm.	1
		V. Wilson pers. comm.	1
New York	Erie	* Conant 1940	2
Ohio	Lucas	Conant 1938a	
		Conant 1938b	50
		Conant 1940	13

Ohio	Lucas	Mattlin 1948	1
		E.J. Tramer pers. comm.	3
		R.H. Eversole pers. comm.	
		R.B. Bury pers. comm.	2
	Wood	Conant 1938a	
		R.H. Eversole pers. comm.	
	Ottawa	This study 1973	1
		Conant 1938a	
		Triplehorn 1955	1
		Langlois 1964	1
		R.H. Eversole pers. comm.	
		A.M. White pers. comm.	23
	Sandusky	Conant 1938a	
		Meeks 1968	3
		R.H. Eversole pers. comm.	
	Erie	Morse 1902 and 1904	
		Conant 1938a	
		Conant 1940	3
		Amorose 1958	2
		Conant 1965	2
		R.H. Eversole pers. comm.	
		R.B. Bury pers. comm.	1
	Summit	R.B. Bury pers. comm.	1
Ontario	Essex	This study 1972 and 1973	145 (incl. 11 recaptures)
		Patch 1919	
		Logier 1925	3
		Conant 1940	7
		Mills 1948	
		Logier and Toner 1961	
		Dutcher 1967	24
		Pentudi	35 (incl. 6 recaptures)
		Wyett and Burhoe 1969	30 (incl. 2 recaptures)
		Gemmell 1970	32 (incl. 1 recapture)
		Cook 1970	
		Campbell 1971a	6
		F.D. Ross (PC: F.R. Cook)	50 (incl. 2 recaptures)
		E.J. Crossman pers. comm.	6
		R.B. Bury pers. comm.	1
		F.R. Cook pers. comm.	26
		J.T. Collins pers. comm.	

Kent	This study 1973	8
	Logier and Toner 1961	
	McBride 1962	24
	Cook 1970	
	Campbell 1971b	
	E.J. Crossman pers. comm.	2
	F.R. Cook pers. comm.	10
	R.B. Bury pers. comm.	1
Norfolk	Logier 1931	37
	Logier 1939	
	Conant 1940	11
	Mills 1948	
	Evans and Roecker 1951	3
	Adams and Clark 1958	18
	Logier and Toner 1961	
	Cook 1970	
	V. Wilson pers. comm.	1
	E.J. Crossman pers. comm.	17
	F.R. Cook pers. comm.	5
	D.A. Smith pers. comm.	8
Lambton	F.R. Cook pers. comm.	1
Bruce	Conant 1940	1
	Mills 1948	
	Logier and Toner 1961	
	E.J. Crossman pers. comm.	2
	R.B. Bury pers. comm.	
Simcoe	Logier and Toner 1961	1
	F.R. Cook pers. comm.	
Muskoka	Mills 1948	
	Logier and Toner 1961	
	McBride 1961	1
	Gemmell 1974	3
	F.R. Cook pers. comm.	3
	D.A. Smith pers. comm.	1
	G.E. Gemmell pers. comm.	6

Parry Sound	Conant 1940	4
	Mills 1948	
	Logier and Toner 1961	
	E.J. Crossman pers. comm.	6
	F.R. Cook pers. comm.	1
	J. Vriedenheim pers. comm.	2
York	* Logier and Toner 1961	1
	and E.J. Crossman pers. comm.	
Lanark	* Bleakney 1958 and	1
	F.R. Cook pers. comm.	
Grenville	* Bleakney 1958 and	1
	F.R. Cook pers. comm.	
Carleton	* Bleakney 1958 and	1
	F.R. Cook pers. comm.	

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