Division of Wildlife
Ohio Department of Natural Resources

SPRING 2016 FURBEARER ROADKILL SURVEY

In 1979, the ODNR Division of Wildlife (division) began conducting roadkill surveys in March, April, July, and August for furbearers and small game mammals. These surveys allowed the division to monitor relative changes in population sizes. From 1979-2002, species recorded on the survey routes included raccoons (*Procyon lotor*), muskrats (*Ondatra zibethicus*), foxes (gray [*Urocyon cinereoargenteus*] and red foxes [*Vulpes vulpes*] combined), opossums (*Didelphis virginiana*), striped skunks (*Mephitis mephitis*), mink (*Mustela vison*), woodchucks (*Marmota monax*), eastern cottontail rabbits (*Sylvilagus floridanus*), and tree squirrels (gray [*Sciurus carolinensis*] and fox squirrels [*Sciurus niger*] combined).

In 2003, surveys were limited to spring (March and April) and observations limited to raccoons, opossums, skunks, and woodchucks. Roadkill surveys provide the most reliable indices to population change for relatively abundant species. Further, larger bodied species (e.g., raccoons) are more likely to persist on the road and be more visible than smaller bodied ones (e.g., gray squirrels). Spring roadkill surveys provided adequate information regarding population trends for these species, without additional summer (July and August) surveys.

METHODS

Forty-nine 40-mile survey routes were distributed throughout Ohio. Routes were driven three times during March and again in April (6 replicates per route), with at least seven days between surveys. Routes were driven in the morning at speeds of less than or equal to 40 miles per hour. The number of road-killed raccoons, opossums, skunks, and woodchucks were tabulated by species. Roadkill surveys are an efficient way to index population size of medium-to-large-bodied mammals that are frequently found on roads.

The number of roadkills/1,000 miles (roadkill rate) statewide was calculated for each species. Additionally, roadkill rate was calculated for survey routes within each of the following regions: lake plain (6 routes), till plain (19 routes), glaciated (10 routes), and unglaciated (14 routes; Fig. 1). Finally, the 2016 survey results were compared with spring surveys conducted during 1989-2015, and inferences regarding population trends for the four species were made both statewide and regionally.

RESULTS

All routes were driven three times during March and April providing 11,760 survey miles during spring 2016. Roadkill rates (roadkills/1,000 miles) were 41.4 for raccoons, 43.7 for opossums, 11.5 for skunks, and 7.2 for woodchucks. Relative abundance varied by region (Table 1).

During 1989–2016, roadkill rates varied from 20.4 to 63.8 for raccoons, 33.6 to 89.5 for opossums, 11.5 to 31.7 for skunks, and 6.9 to 27.5 for woodchucks (Fig. 2). Overall trends indicated increasing relative abundance of raccoons ($\beta = 0.32$, annual percent change = 0.8%; where β represents the expected change in roadkills/1,000 mi for each additional year, and annual percent change equals [β/roadkill rate] x 100). Annual population trend was decreasing for opossums ($\beta = -0.96$; annual percent change = -2.2%) and skunks ($\beta = -0.48$; annual percent change = -4.2%). However, annual percent decline was greatest for the woodchuck index ($\beta = -0.66$; annual percent change = -9.2%; Fig. 2). Although raccoon indices have an increasing trend overall, they have been relatively stable over the past 15–20 years.

Raccoons exhibited a slight increasing trend in all regions, except the glaciated region, where the annual percent change was negative but near zero (Table 1; Fig. 3). Opossum trends were declining in all regions, however, the annual percent change was relatively small (less than 5%; Table 1; Fig. 4). Skunks likewise exhibited negative trends in all regions; the decline was highest in the glaciated region (-10.10%; Table 1; Fig. 5). Woodchucks exhibited the strongest declines and significant declines occurred in all regions, with the greatest declines in the till plain (-11.46%) and unglaciated regions (-10.60%; Table 1; Fig. 6).

DISCUSSION

Since the 1940s, raccoons have been increasing in number and range throughout North America. Declines in raccoon harvest due to low pelt prices are partially responsible for the increase. Substantial increases in urbanization, however, also began in the 1940s and continue today. Raccoons are habitat and dietary generalists and exhibit a great deal of adaptability. Opossums and skunks are also generalist mesopredators, but raccoons utilize anthropogenic resources with much greater efficiency than either of these species. Thus, the relative increase in raccoons across Ohio is not surprising and is similar to trends elsewhere in North America.

Both opossums and skunks are prone to intermittent fluctuations in population size. Major mortality factors for skunks are typically disease-related, and diseases and/or parasites may serve to reduce population sizes periodically. Winter severity may also affect skunk population size, although its effect is dependent upon skunk condition at the onset of winter. Opossum populations, however, are more likely to be affected by winter weather, with substantial mortality occurring in more severe winters. Nonetheless, over 28 years of roadkill surveys, a clear declining trend for both of these species has emerged. The cause for this decline is unknown, although take by nuisance trappers, as opossums and skunks are common nuisance species (Bluett et al. 2003), and competition and/or disease transmission caused by the more numerous raccoon (Prange and Gehrt 2004) may be factors. Continued surveillance of these populations is warranted.

The reasons for the continuing low roadkill rates and high rates of decline for woodchucks are also unknown. Woodchucks are considered nuisances by many

people and declines may be at least in part due to increased pest control. Additionally, the arrival and subsequent increase of coyotes in Ohio may also be partly responsible for the decline. Woodchucks have been known to be affected by the raccoon roundworm, *Baylisascaris procyonis,* which is non-symptomatic in raccoons but can be lethal in other species (Jacobson et al. 1976). Given the rate of decline and the lack of information concerning the cause, additional observation is also warranted for woodchucks.

Roadkill surveys produce an index to abundance rather than a population estimate. Indices are often used as a cost-effective method for long-term monitoring and provide a way to track relative abundances of species through time. However, roadkill surveys, like all indices, are subject to a number of biases and should be interpreted with caution (Case 1978). Extraneous factors, such as annual variation in weather or changes in traffic volume can influence yearly roadkill rates. Despite potential biases, roadkill surveys can provide reliable indicators of population trends for abundant species, although they are less reliable in the detection of small changes in low-density populations (Gehrt 2002).

Bowhunter surveys provide an additional, independent source of information regarding annual changes in the relative abundance of raccoons, opossums, and skunks. These two sources of data are in agreement in the overall trends for these three species. However, the roadkill survey is the only monitoring tool we have for woodchucks. Given their declining rates, additional survey methods for woodchucks should be explored.

LITERATURE CITED

Bluett, R.D., G.F. Hubert, Jr., and C.A. Miller. 2003. Regulatory oversight and activities of wildlife control operators in Illinois. Wildlife Society Bulletin 31:104–116.

Case, R.M. 1978. Interstate highway road-killed animals: a data source for biologists. Wildlife Society Bulletin 6: 8–13.

Gehrt, S.D. 2002. Evaluation of spotlight and road-kill surveys as indicators of local raccoon abundance. Wildlife Society Bulletin 30:449–456.

Jacobson H.A., P.F. Scanlon, V.F. Nettles, and W.R. Davidson. 1976. Epizootiology of an outbreak of cerebrospinal nematodiasis in cottontail rabbits and woodchucks. Journal of Wildlife Diseases 12:357–60.

Prange, S., and S.D. Gehrt. 2004. Changes in mesopredator-community structure in response to urbanization. 82:1804–1817.

Table 1. Roadkill rates (RK rates; roadkills/1,000 miles), slope (β), and percent annual change in index (%) by region in Ohio during spring 2016.

	Raccoons			**Opossums**			**Skunks**			**Woodchucks**		
Region	RK rate	β	%	RK rate	β	%	RK rate	β	%	RK rate	β	%
Lake plain	58.3	1.07	1.83	23.6	-0.60	-2.54	20.8	-0.20	-0.96	4.2	-0.33	-7.92
Till plain	56.6	0.65	1.14	47.8	-0.66	-1.38	14.0	-0.46	-3.29	5.1	-0.59	-11.46
Glaciated	38.7	-0.18	-0.46	33.7	-1.38	-4.09	7.9	-0.80	-10.10	13.3	-0.77	-5.77
Unglaciated	23.5	0.04	0.17	60.7	-1.23	-2.03	8.6	-0.36	-4.17	7.7	-0.82	-10.60

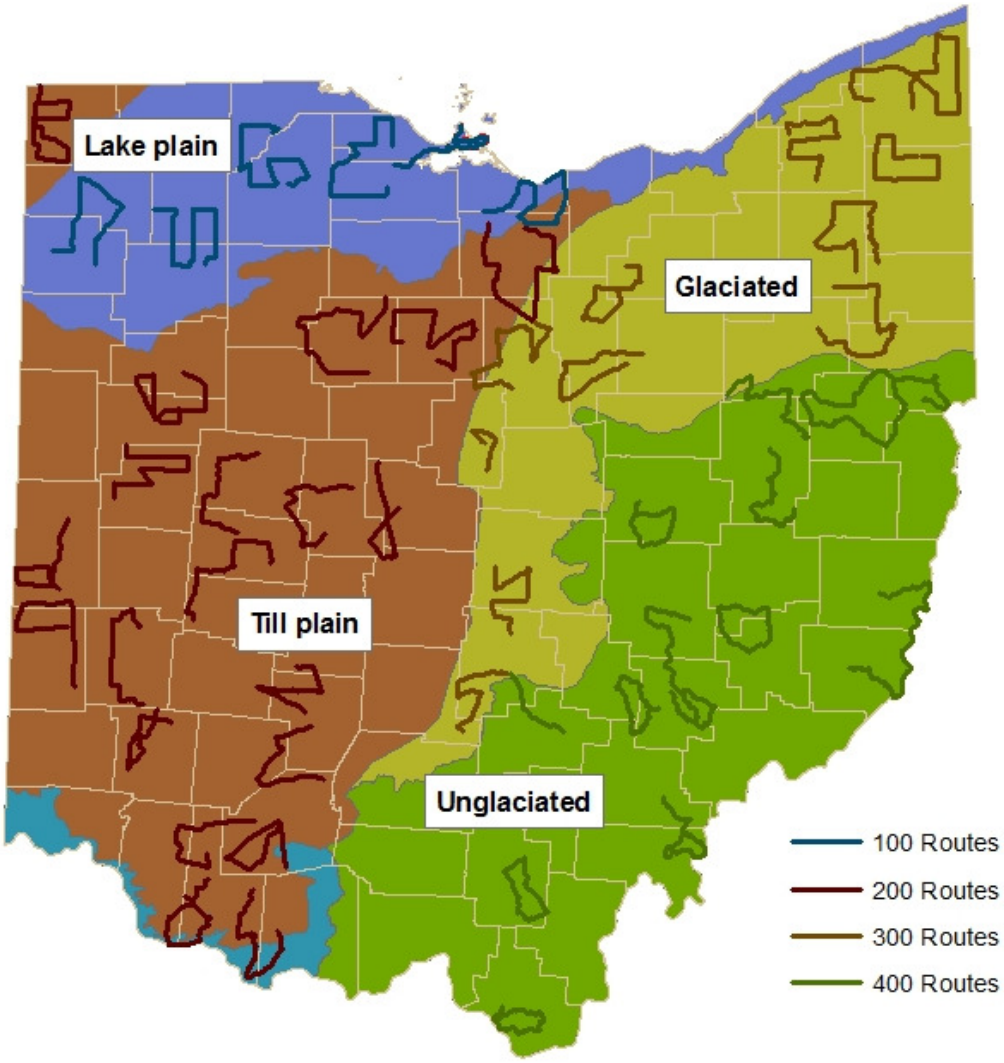

Fig. 1. Roadkill routes by the four major physiographic regions in Ohio used to stratify results by habitat.

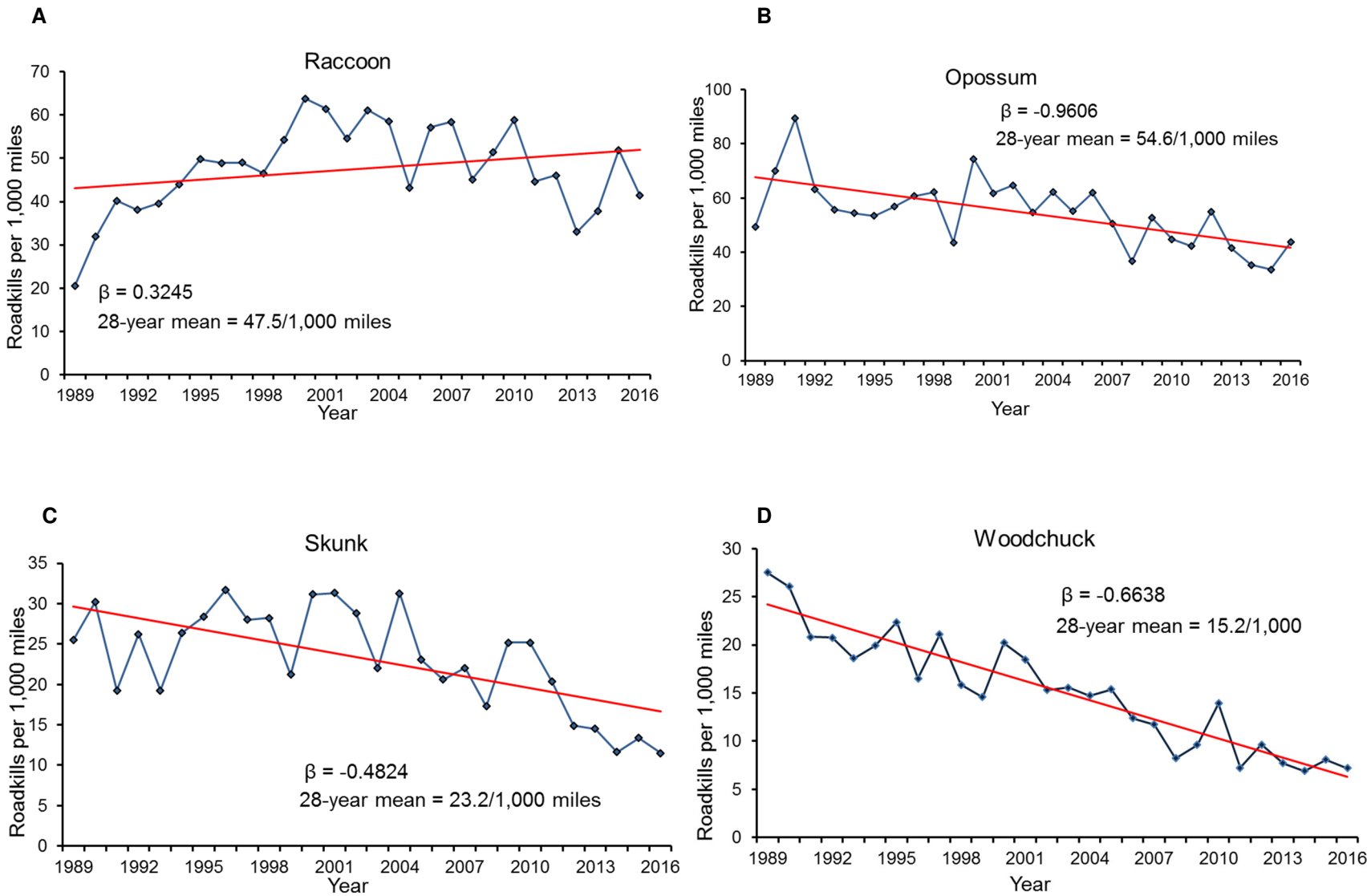

Fig. 2. Roadkill rates (roadkills/1,000 miles) in Ohio during spring by year for A) raccoons, B) opossums, C) striped skunks, and D) woodchucks from 1989-2016. Red line indicates overall trend.

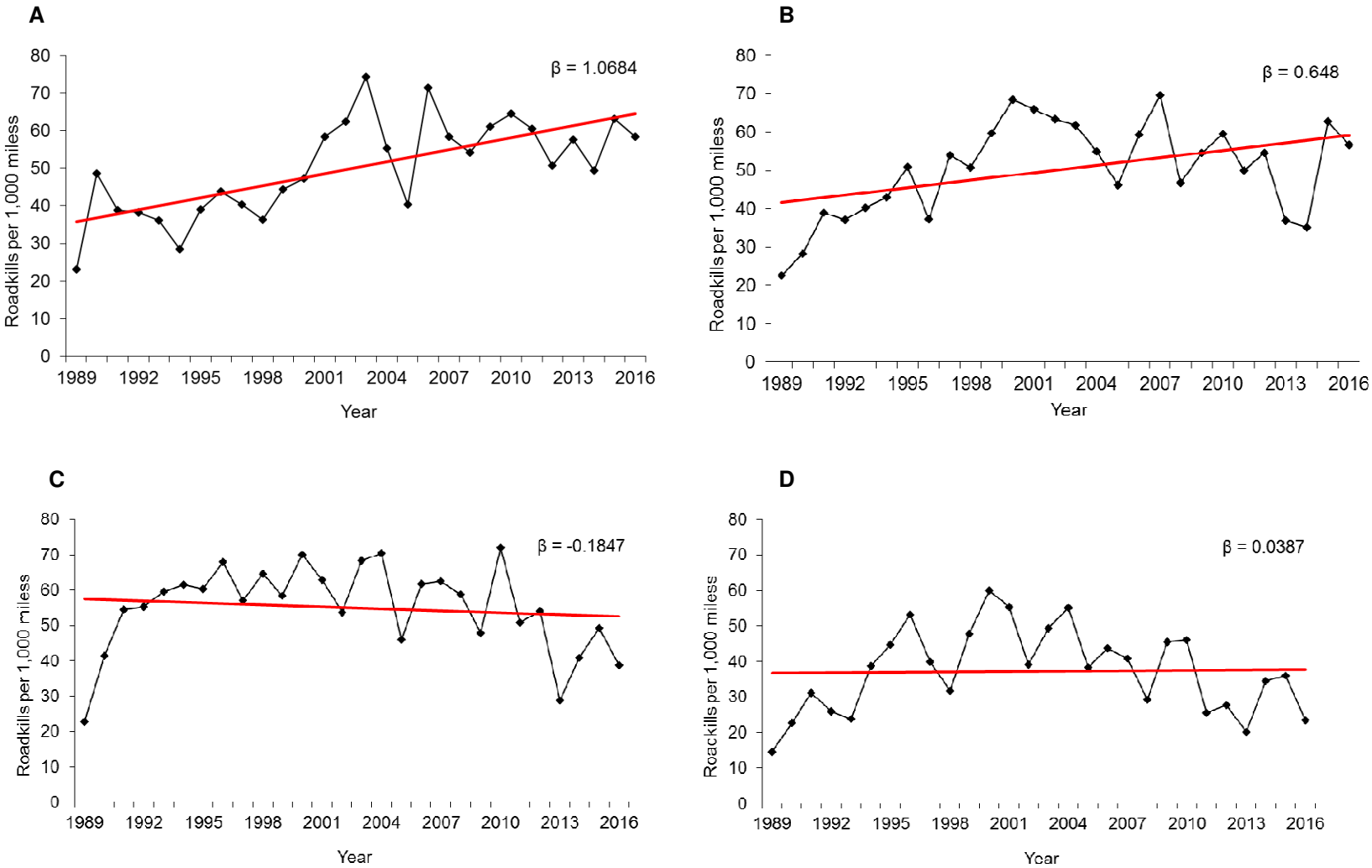

Fig. 3**.** Roadkill rates (roadkills/1,000 miles) for raccoons during spring by year for A) lake plain, B) till plain, C) glaciated, and D) unglaciated regions from 1989-2016. Red line indicates overall trend.

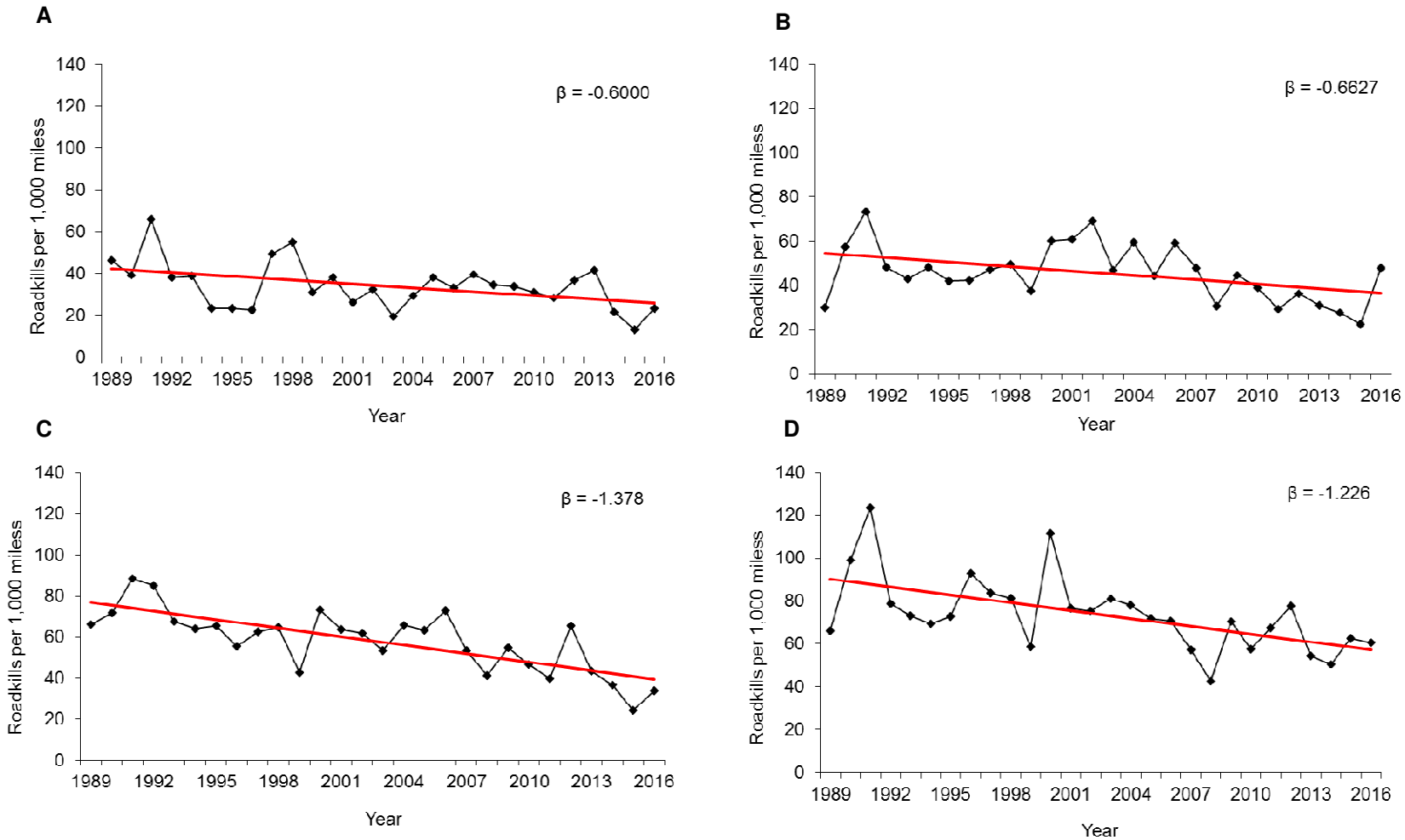

Fig. 4**.** Roadkill rates (roadkills/1,000 miles) for opossums during spring by year for A) lake plain, B) till plain, C) glaciated, and D) unglaciated regions from 1989-2016. Red line indicates overall trend.

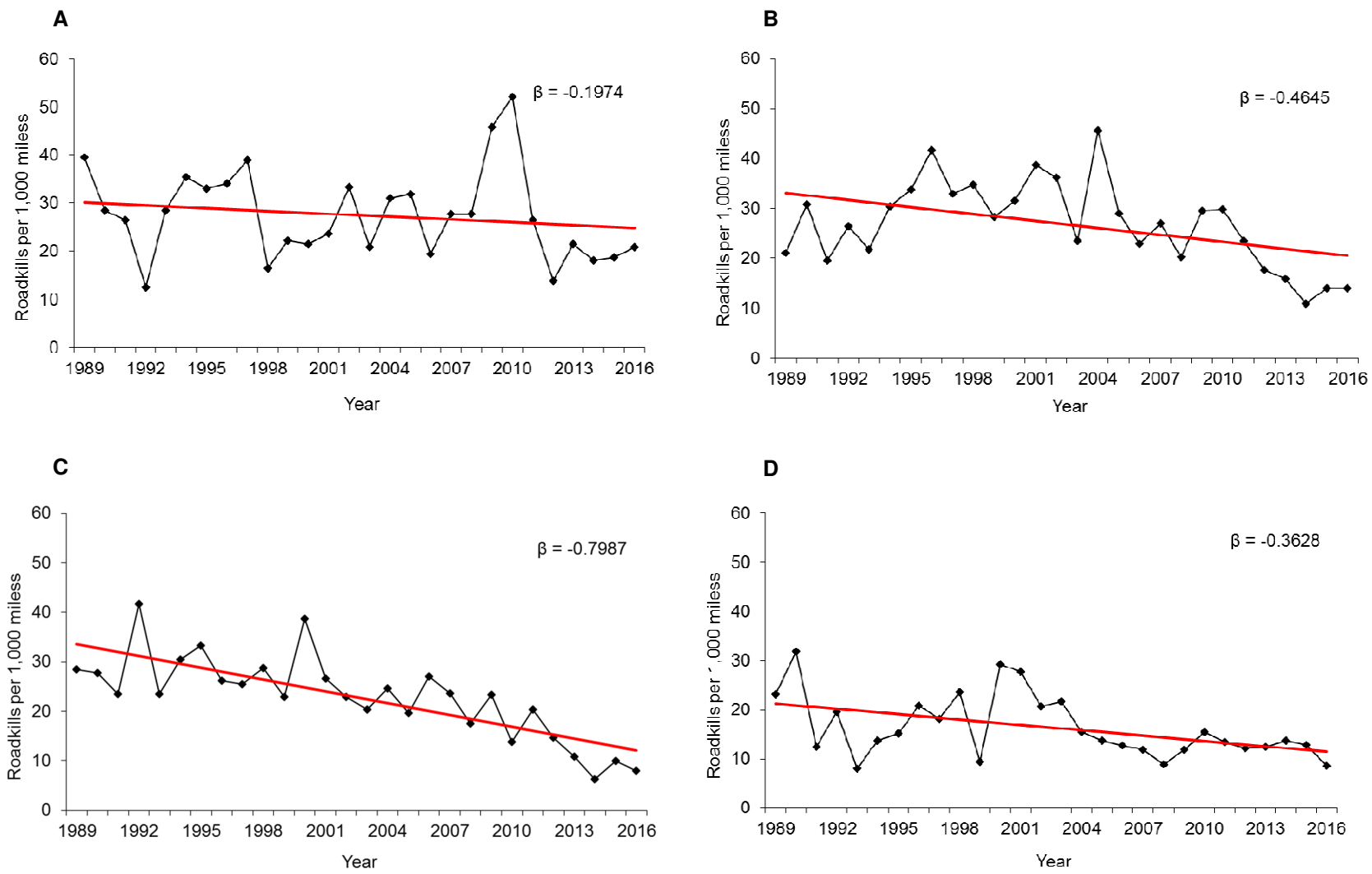

Fig. 5. Roadkill rates (roadkills/1,000 miles) for striped skunks during spring by year for A) lake plain, B) till plain, C) glaciated, and D) unglaciated regions from 1989-2016. Red line indicates overall trend.

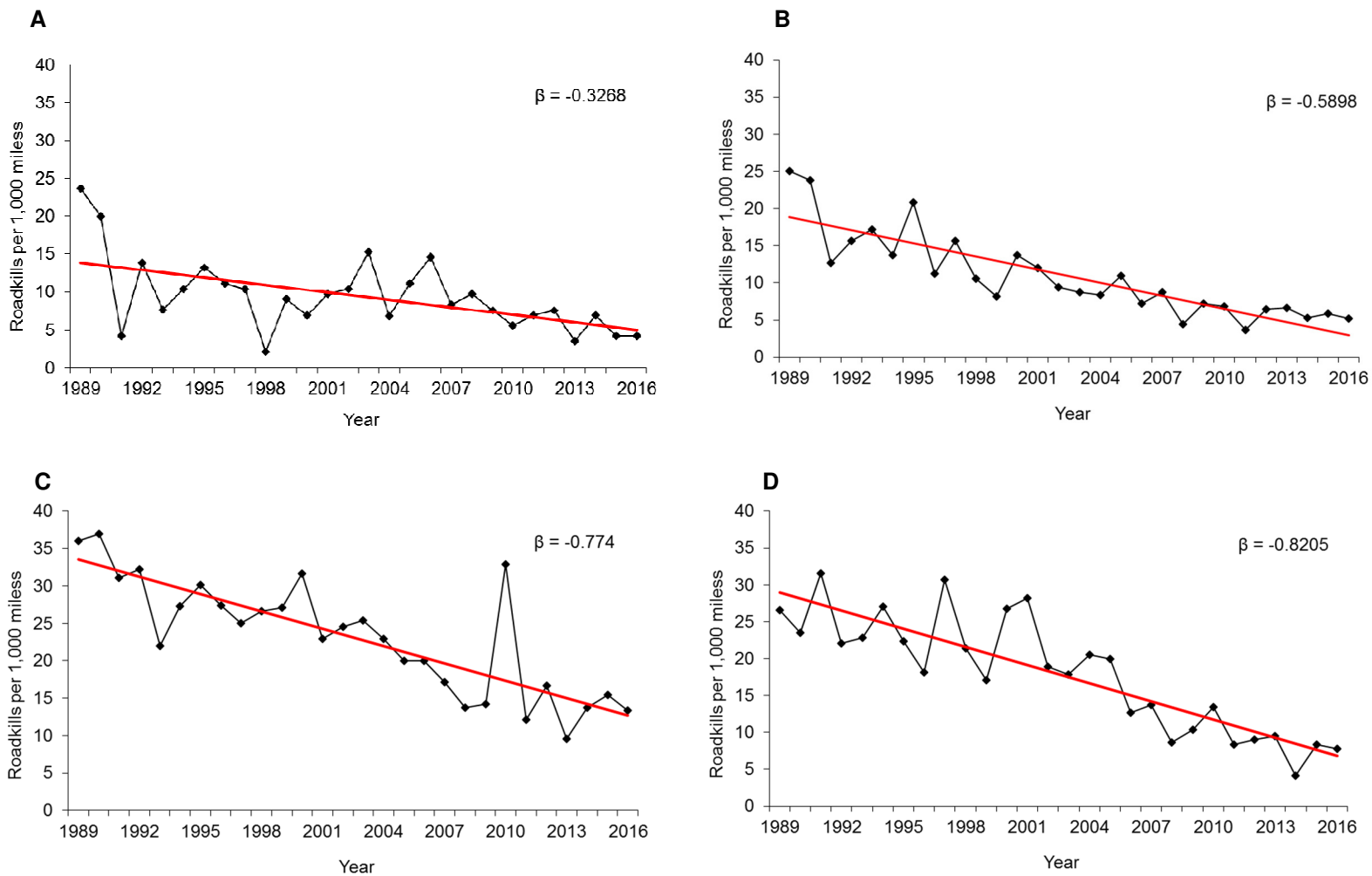

Fig. 6. Roadkill rates (roadkills/1,000 miles) for woodchucks during spring by year for A) lake plain, B) till plain, C) glaciated, and D) unglaciated regions from 1989-2016. Red line indicates overall trend.