RABIES ON MEXICO'S NORTHERN BORDER, 1969-1980[1]

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Data relating to a Mexican rabies control program in that country's northern border region show that rabies poses an important public health problem in several frontier cities. This point is particularly noteworthy because of the declining manpower and other resources devoted to the program in recent years.

Introduction

The United States-Mexico Border is 3,183 km long, running overland for 1,117 km and along rivers for 2,066 km (see Figure 1). Geographically, the border area is a desert plain broken by a mountainous zone in the region of the two Californias. The border's highest altitude is 1,200 meters above sea level, which is reached where the border passes by Douglas, Arizona (U.S.A.) and Agua Prieta, Sonora (Mexico).

The climate of this region is arid or semiarid, the annual rainfall being less than 5.1 cm. What rain there is normally falls between June and October—except on the Pacific Coast, where it rains in the winter months *(1)*. The typically desert fauna includes a wide variety of mammals, most notably coyotes, foxes, skunks, and a number of bat species *(2-3)*.

In 1961 Mexico's Secretariat of Public Health and Social Welfare (SSA) launched a border rabies control program (PRF) as part of its national rabies control program. The aim of both these programs is to reduce canine rabies in urban areas.

The border program covers 12 border cities, which were incorporated into it by stages. In 1966 the program was extended to five cities—these being Ensenada, Tijuana, and Mexicali in Baja California and San Luis Río Colorado and Nogales in Sonora. In 1967 coverage was given to Agua Prieta in Sonora and Ciudad Juárez in Chihuahua. Finally, in 1968 the remaining cities—Ciudad Acuña and Piedras Negras in Coahuila and Nuevo Laredo, Reynosa, and Matamoros in Tamaulipas—were included.

The program's strategy consists of trying to provide an annual vaccination against rabies for all dogs over four months old; holding dogs known to have bitten a person for 10 days of observation; and capturing and eliminating strays. At SSA request, the Pan American Health Organization has been working directly with the border rabies control program—providing technical assistance, preparing epidemiologic studies, and occasionally furnishing such resources as vaccines and vehicles. This PAHO work includes the monthly publication of an epidemiologic bulletin that summarizes information contained on the PRF-1 report forms designed by the SSA in collaboration with PAHO.

Available Data

The information submitted weekly to the PAHO Field Office by the state headquarters of the SSA's coordinated services in the six border states has been analyzed for the period 1969-1980. These data show that rabies is an ongoing problem in the border cities, even though no canine or human cases were reported from four of the 12 cities (Ensenada, Tijuana, Nogales, and Matamoros) during the last five years of the study period. Dogs are the animals most often found positive for

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Figure 1. A map of the Mexico-United States border area showing the 12 cities covered.

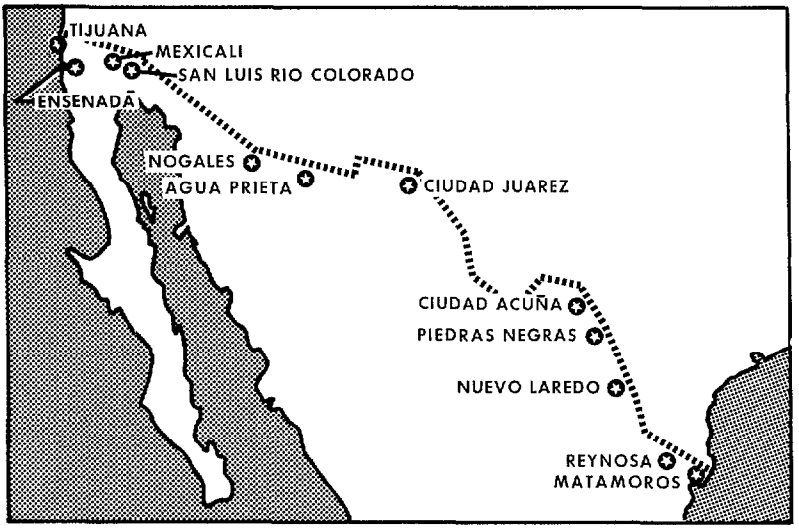

Table 1. Laboratory-confirmed animal rabies cases in the 12 border cities in 1969-1980; except where specifically indicated, the figures reflect only canine cases.

City	Number of reported cases												
	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	Total
Ensenada	3	0	0	0	0	0	1	0	0	0	0	0	4
Tijuana	20	0	0	0	0	1	1[a]	0	0	0	0	0	22
Mexicali	53	14	1	0	0	2	0	2	0	4	28	14	118
San Luis Río Colorado	1	0	0	0	0	0	0	0	1	0	0	0	2
Nogales	3	0	4	39	0	6	0	0	0	0	0	0	52
Agua Prieta	0	0	0	0	0	0	0	3	1	0	0	0	4
Ciudad Juárez	5	1	0	0	4	128	54	8	0	4	151	41	396
Ciudad Acuña	6	0	0	0	2	0	1	0	1	1[b]	0	0	11
Piedras Negras	2	0	0	1	0	1	0	0	0	3	9	15	31
Nuevo Laredo	4[c]	0	4	1	2	1	0	2[c]	27	2	0	3	46
Reynosa	17	2	0	2	0	0	0	0	2	1	2	4	30
Matamoros	20	5	1	2	0	0	0	0	0	0	0	0	28
Total	134	22	10	45	8	139	57	15	32	15	190	77	744

[a]Infected cat.
[b]Infected rat.
[c]Three infected cats.

rabies in the border cities; no information about infected wildlife is available.

On the average for the period—and in the years 1974, 1975, 1979, and 1980—Ciudad Juárez had by far the largest number of laboratory-confirmed canine rabies cases (Table 1). The city with the second highest number of canine cases overall was Mexicali.

The total number of laboratory-confirmed animal rabies cases reported in the 12 cities in 1969-1980 was 744. Peak numbers of cases occurred in 1969 (134 cases, of which 53 oc-

curred in Mexicali), in 1974 (139 cases, of which 128 occurred in Ciudad Juárez), and in 1979 (190 cases, of which 151 occurred in Ciudad Juárez and 28 occurred in Mexicali).

A total of seven human rabies cases were recorded in the 12 cities during the study period. All but one of these occurred in Ciudad Juárez (two in 1967 and four in 1979), the remaining case being recorded in Piedras Negras in 1979.

In accordance with the program's strategy, estimates of the total dog population to be vaccinated were drawn up, based on the assumption that the dog population more or less corresponded to 10 per cent of the human population. However, the human population data used were derived from the 1970 census, and these differed from estimates prepared by local authorities—primarily because of rapid increases in the populations of several border cities. In terms of the targets set on the basis of 1970 census projections, the average canine vaccination coverage achieved was 60 per cent.

In addition, a total of 342,865 stray animals were captured during the period 1969-1979; 80 per cent of these were destroyed.

The total number of people reported bitten in 1969-1979 was 99,699, the average number of bites per 100,000 inhabitants per year being about 500 (see Table 2). Some 60 per cent of these biting incidents occurred on the street.

Discussion

The pattern of rabies varies in each of the 12 cities; Ciudad Juárez, Mexicali, and Nuevo Laredo are the cities where animal rabies has been most frequently reported. Of these three, Ciudad Juárez has the highest attack rate.

The information analyzed indicates that rabies in the border area as a whole tends to show peaks every five years (see Table 1). There are several reasons for this cyclical pattern, including a low level of vaccination coverage resulting partly from underestimation of the canine population. This underestimation arose from the assumptions used—including the assumption that the canine population was 10 per cent of the human population, a hypothesis that has not been proved valid for the border region. This problem was compounded by the fact that reliable data on the human populations of the 12 cities were not available.

Further difficulty has resulted from diminishing manpower and other resources. A total of 130 officials were assigned to the border

Table 2. Estimated numbers of people bitten per 100,000 inhabitants in the 12 study cities, 1969-1980.

City	Average no. of people bitten per 100,000 inhabitants												Average of the annual figures for each city, 1969-1980
	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	
Ensenada	1,779	1,085	1,009	667	426	465	665	629	493	442	536	410	717
Tijuana	525	423	429	388	334	383	425	394	358	302	324	242	370
Mexicali	543	621	453	344	400	366	404	425	394	347	572	432	442
San Luis Río Colorado	689	723	780	748	677	725	877	878	726	713	910	793	770
Nogales	656	818	940	1,016	844	810	757	829	726	647	432	576	754
Agua Prieta	670	567	594	547	591	504	420	435	540	514	415	534	528
Ciudad Juárez	384	429	466	462	280	763	555	464	442	407	806	543	500
Ciudad Acuña	516	378	205	177	186	233	144	159	275	176	132	203	232
Piedras Negras	527	514	509	542	476	466	479	353	482	499	956	827	553
Nuevo Laredo	376	344	336	268	194	218	207	229	377	267	197	188	267
Reynosa	631	502	375	457	362	356	400	315	376	373	413	420	415
Matamoros	771	563	384	348	372	351	367	289	295	262	507	460	414

program in 1969, as compared to 71 in 1979 *(5)*. Three operating diagnostic laboratories were participating in 1969, while only one was participating at the end of the study period. Overall, the program's facilities have deteriorated over the course of time and the rate of replacement has been slow.

Regarding vaccination activities (Figure 2), a study by Damude and Campos Terrón *(5)* derived a number of indexes from data obtained during the program's 1969 attack phase, which succeeded in reducing the incidence of cases. Among other things, they found that the incidence of canine rabies declined when the vaccination rate reached 6.6 dogs per 100 inhabitants. The average rate for the period of our study was 6.53, but it should be noted that after 1973 the average rate achieved in the 12 cities taken together was lower than the 6.6 index except in 1977, the epidemic year 1979, and 1980 (Table 3). Moreover, vaccination of an estimated 11 dogs per 100 inhabitants in Ciudad Juárez in 1979 failed to produce speedy control of the outbreak that occurred near the beginning of that year.

Taking the 12 year study period as a whole, San Luis Río Colorado maintained the highest average rate of annual vaccinations (10.5 canine immunizations per 100 inhabitants—see Table 3). Six cities had annual rates averaging below the 6.6 index figure, and the remaining five cities had annual rates averaging slightly above that figure.

Paralleling their vaccination index, Damude and Campos Terrón established an index for captures—the rate of captures indicated for control being on the order of 2.2 dogs per 100 inhabitants. As Table 4 shows, during the period 1969-1980 only Agua Prieta and San Luis Río Colorado consistently surpassed this level, and the average annual levels in most of the cities have tended to decline.

Conclusions

The information available shows urban canine rabies to pose an important veterinary public health problem in several cities along Mexico's northern border.

Of the twelve cities, Ciudad Juárez appears to be the most critically affected. Overall, it

Figure 2. The total estimated canine population and the canine vaccination coverage achieved in Mexico's northern border cities in 1969-1979, as plotted on a logarithmic scale.

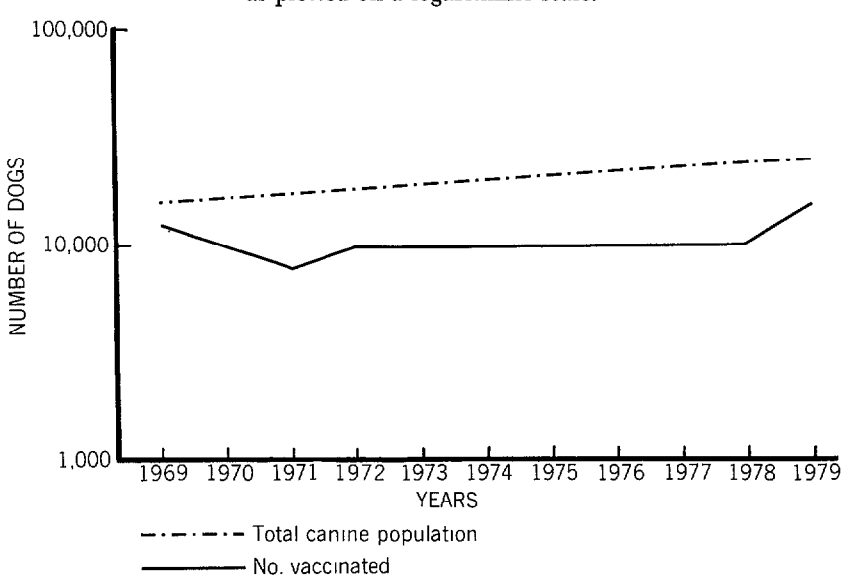

Table 3. Estimated numbers of dogs vaccinated annually against rabies per hundred human inhabitants in the 12 study cities, 1969-1980.

City	Average no. of vaccinations per 100 inhabitants												Average of the annual figures for each city, 1969-1980
	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	
Ensenada	10	11	2	4	4	5	5	7	6	3	4	8	5.8
Tijuana	9	6	4	4	4	5	4	4	4	3	5	8	5.0
Mexicali	8	7	5	5	4	4	2	5	4	8	8	7	5.6
San Luis Río Colorado	15	11	7	12	10	9	9	8	10	8	12	15	10.5
Nogales	9	6	4	5	6	5	4	3	2	8	9	10	5.9
Agua Prieta	16	6	7	9	7	4	4	4	8	8	11	10	7.8
Ciudad Juárez	6	6	6	6	5	7	9	6	7	6	11	10	7.1
Ciudad Acuña	12	12	6	8	6	5	4	4	4	6	5	5	6.4
Piedras Negras	12	11	8	10	5	9	7	7	6	5	4	4	7.3
Nuevo Laredo	6	3	4	3	4	3	3	4	9	6	6	6	4.8
Reynosa	11	7	4	6	6	6	5	6	10	6	9	11	7.3
Matamoros	11	6	6	4	4	4	3	3	5	2	3	6	4.8
Overall annual and 1969-1980 averages	10.42	7.66	5.25	6.33	5.42	5.5	4.92	5.08	6.25	5.75	7.25	8.33	6.53

Table 4. Estimated numbers of stray dogs captured per 100 human inhabitants in the 12 study cities, 1969-1980.

City	Average no. of dogs captured per 100 inhabitants												Average of the annual figures for each city, 1969-1980
	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	
Ensenada	6	6	6	2	2	2	2	1	1	1	2	1	2.7
Tijuana	2	2	2	2	2	1	1	1	1	1	1	1	1.4
Mexicali	2	2	2	1	1	1	1	1	1	1	1	1	1.3
San Luis Río Colorado	5	2	2	3	5	5	4	5	3	3	3	15	4.6
Nogales	3	2	1	3	2	3	2	2	2	3	3	3	2.4
Agua Prieta	4	4	5	4	6	4	3	2	4	2	3	3	3.7
Ciudad Juárez	2	2	2	1	1	2	1	1	1	1	2	1	1.4
Ciudad Acuña	2	1	2	2	1	3	3	3	1	2	3	<1	2.0
Piedras Negras	6	6	3	1	5	3	2	1	<1	<1	<1	<1	2.4
Nuevo Laredo	3	1	2	2	2	2	3	2	1	1	<1	<1	1.8
Reynosa	2	2	2	1	1	1	1	1	<1	<1	<1	<1	1.1
Matamoros	3	2	1	<1	<1	1	1	<1	1	1	<1	<1	1.0
Overall annual and 1969-1980 averages	3.3	2.6	2.5	1.9	2.4	2.3	2	1.7	1.4	1.3	1.6	2.2	2.2

reported canine cases in 10 of the 12 years under review. In 1979, an epidemic year for the city, 151 canine cases, 4,400 biting incidents, and four human cases were reported.

The border rabies control program's resources have diminished or deteriorated in the course of time. Existing vaccination coverage targets are not adequate, since they are based on an inadequate dog-to-population indicator and upon human populations whose sizes are not accurately known; furthermore, the indicators developed by Damude and Campos Terrón from information on program activities during the attack phase (1969) do not appear ideally suited for evaluating the program. Capture of stray dogs, a very necessary program support activity in the border cities, has not been maintained at the relatively high levels achieved in the program's early years.

SUMMARY

Data relating to a Mexican rabies control program along that country's northern frontier provide a basis for assessing the status of rabies in 12 of Mexico's border cities from 1969 through 1980. These data indicate that 744 animal cases and seven human cases were reported from the 12 cities in this period, with Ciudad Juárez accounting for over half the animal cases and all but one of the human cases. In all, 99,699 biting incidents were reported in 1969-1979, and 3,429 specimens were submitted for laboratory diagnosis. An average of roughly 6.4 dogs per 100 inhabitants were vaccinated annually against rabies in 1969-1980, and about 2.2 stray dogs per hundred inhabitants were captured annually.

Overall, these data show that rabies is an important veterinary public health problem in the border region. Nevertheless, the border rabies control program's human resources and facilities diminished markedly over the 12 year period in question. Moreover, existing targets for vaccination coverage need to be revised, and assessment indicators developed during the attack phase in 1969 do not now appear well-suited to program evaluation. Capture of stray dogs, a very necessary program support activity in the border cities, has not been carried out at the relatively high rate achieved in the program's early years.

REFERENCES

(1) Romero Alvarez, H. Salud sin fronteras. Asociación Fronteriza Mexicano-Estadounidense de Salud, Mexico City, 1975.

(2) Olin, G. *Mammals of the Southwest Desert.* Popular Series No. 8. Southwest Parks and Monuments Association, 1975.

(3) Barbour, R. W., and H. W. Davis. *Bats of America.* Kentucky University Press; Lexington, Kentucky, 1969.

(4) México, Secretaría de Salubridad y Asistencia. Normas para el desarrollo del programa nacional antirrábico. Mexico City, 1979.

(5) Damude, D., and J. M. Campos Terrón. Evaluación de programas de control de la rabia en zonas urbanas de la frontera norte de México. *Bol Of Sanit Panam* 78:241-257, 1975.