

## CONSOLIDATION OF THE CONTROL OF CHAGAS' DISEASE VECTORS IN THE STATE OF SÃO PAULO

ANTONIO GUILHERME DE SOUZA, DALVA MARLY VALÉRIO-WANDERLEY, GERALDO MAGELA BURALLI & JOSÉ CARLOS REHDER DE ANDRADE

### Origin and First Stages of the Program

It is presently accepted that the transmission of Chagas' disease by house bred triatomine is a consequence of the organization of geographic spaces prevailing in the State of São Paulo during one of the stages of territory occupation in the first half of the century – the establishing of coffee cultivation by means of wage earning manpower. In the fifties and even more intensely in the following decade, the rural environment underwent deep social and economic changes, which brought about the collapse of the conditions which had allowed for the expansion and maintenance of the endemic diseases (Silva, 1981).

If, on one hand it takes us to suppose that the existence of Chagas' disease as a rural endemic disease should then loose its social and economic determinants – that is the rural exodus and a decreasing number of rural dwellings, on the other hand there is no doubt that today the natural transmission of the illness would certainly be accomplished, as there was a perfect adaptation between *T. infestans* and the remaining biological components existing in decaying areas, were it not for the control measures that were put into practice (Caldas Jr., 1980). In the early sixties, the government policy of rechanneling productive investments of the agrarian sector back to within State limits, as stated in the official speech on revamping decadent areas, brings about an upsurge of the control actions which had already been started in the fifties. Their resources, though, were not only limited but also directed towards certain areas in which a sanitarian's concern over the gravity of the problem would find response in sensitive local authorities. On the other hand, as the Campaign to Efface Malaria had been successful, there were financial resources and a background structure available for the launching of a widespread attack to house bred vectors by the then called Service for Effacing Malaria and Prophylaxis of Chagas' disease (SEMPDC) (Rocha e Silva, Dias Jr. & Guari-ta, 1969).

The state of the endemic disease in the early fifties can easily be assessed by considering the extent of the infested area – out of the 369 existing Municipalities 231 were infested by triatominae (Lima & Silva, 1952). *Triatoma infestans* was the species most found in dwellings, presenting a rate of infection by *T. cruzi* of around 12% (Corrêa, Lima & Carvalho, 1952). At the same time, Unti & Silva (1952), found a positive complement fixation reaction in 20.02% of the inhabitants of the 65 infested Municipalities.

By the end of the decade, positivity values of triatominae still remained high. According to Corrêa & Ferreira (1959), out of 156,920 *T. infestans* individuals examined in the State, 9.37% were infected by *T. cruzi*. On the other hand, a comprehensive serologic inquest undertaken by SEMPDC in the rural zone of the State showed 9.31% of Machado Guerreiro reaction positive samples (Coutinho 1962). Considering this situation and the fact that the attack stage on most of the malarial area was about to finish (1964), the Service prepared itself financially and technically to widen its spraying activities by means of the "Arrastão" stage of the program. This consisted of spraying rural dwellings of the whole endemic area with BHC at 30% by the end of the first half of 1967. The resulting decrease in infestation of dwellings and annexes by the house bred species was so impressive that by 1968 the Service was able to switch to the selective method introduced by Pedreira Freitas (1963), in which spraying was conditioned to a previous research of the human ecotype and to the certainty of the presence of triatominae. During this stage the chemical Piriza was employed to dislodge triatominae and again 60 and 90 days afterwards, on a second and third spraying of all nidi. In 1968 around 900,000 rural dwellings were researched, out of which only 0.02% presented *T. infestans* and 0.009% presented *T. infestans* infected by *T. cruzi*. The extensive effort undertaken during the "Arrastão" and beginning of the "Selective" stages allowed for an assessment of the relevancy of *Triatoma infestans* as well as that of *Triatoma sordida* and *Panstrongylus megistus*; the latter ones were considered as secondary species because they were predominant in buildings annexed to dwellings, but they proved to have a great potential for becoming domestic. Table I shows the number of individuals of the three species captured from 1953 to 1973 at 5 year intervals within the State.

By observing the data above, one can see that in the five years of selective spraying response to BHC was not homogeneous in the three species considered. *T. infestans* presented a 95% reduction, *T. sordida* and *P. megistus* presented decreases of respectively 70 and 50%. In the same way as for density, changes in distribution areas were also different in the three species. In an attempt to quantify the distribution of species in the State, Buralli, Barata & Colado (1977) compared the distribution found in 68/69 to the one found in 1976 by means of the maximum, minimum and intermediate densities established at the beginning of the selective stage. This is shown in Table II.

TABLE I

Capture of triatominae and their positivity to *T. cruzi* in the state of São Paulo

Year	<i>T. infestans</i>		<i>T. sordida</i>		<i>P. megistus</i>	
	Captured	% Posit.	Captured	% Posit.	Captured	% Posit.
1953	62,678	9.03	851	6.56	2,002	0
1958	16,814	6.69	6,295	0.53	733	0.90
1963	18,464	4.83	25,190	1.12	3,198	1.12
1968	69,229	3.90	114,118	0.43	10,582	0.67
1973	4,081	0.92	37,579	0.75	5,839	5.56

TABLE II

Graduation of triatominae, density by species and number of infested municipalities in the state of São Paulo in 1968/69 and 1976

Species and Year	Number of Municipalities						
	<i>T. infestans</i>		<i>T. sordida</i>		<i>P. megistus</i>		
	Density	1968/69	1976	1968/69	1976	1968/69	1976
High		37	0	72	12	5	2
Average		74	0	95	134	26	24
Low		112	25	66	30	107	64

Thus it is clearly seen that satisfactory results were obtained against *T. infestans* but progress was not as good with the other species. Secondary species proved to be persistent, but on the other hand the low positivity rates presented by *T. sordida* and the restricted area of occurrence of *P. megistus* made it possible to implement the epidemiological surveillance scheme for controlling Chagas' disease in the State after five years of selective combat. This surveillance was based on the scientific knowledge gathered up to then, by means of which the biologic peculiarities of each species as to feeding habits, capacity to become domestic, susceptibility to *T. cruzi*, that is, the differential risk each one of them could present in the epidemiological structure of the disease were shown.

### Surveillance and Situation at Present

This phase of the works was initiated in 1972/1973 and included three main actions that became guidelines for the program:

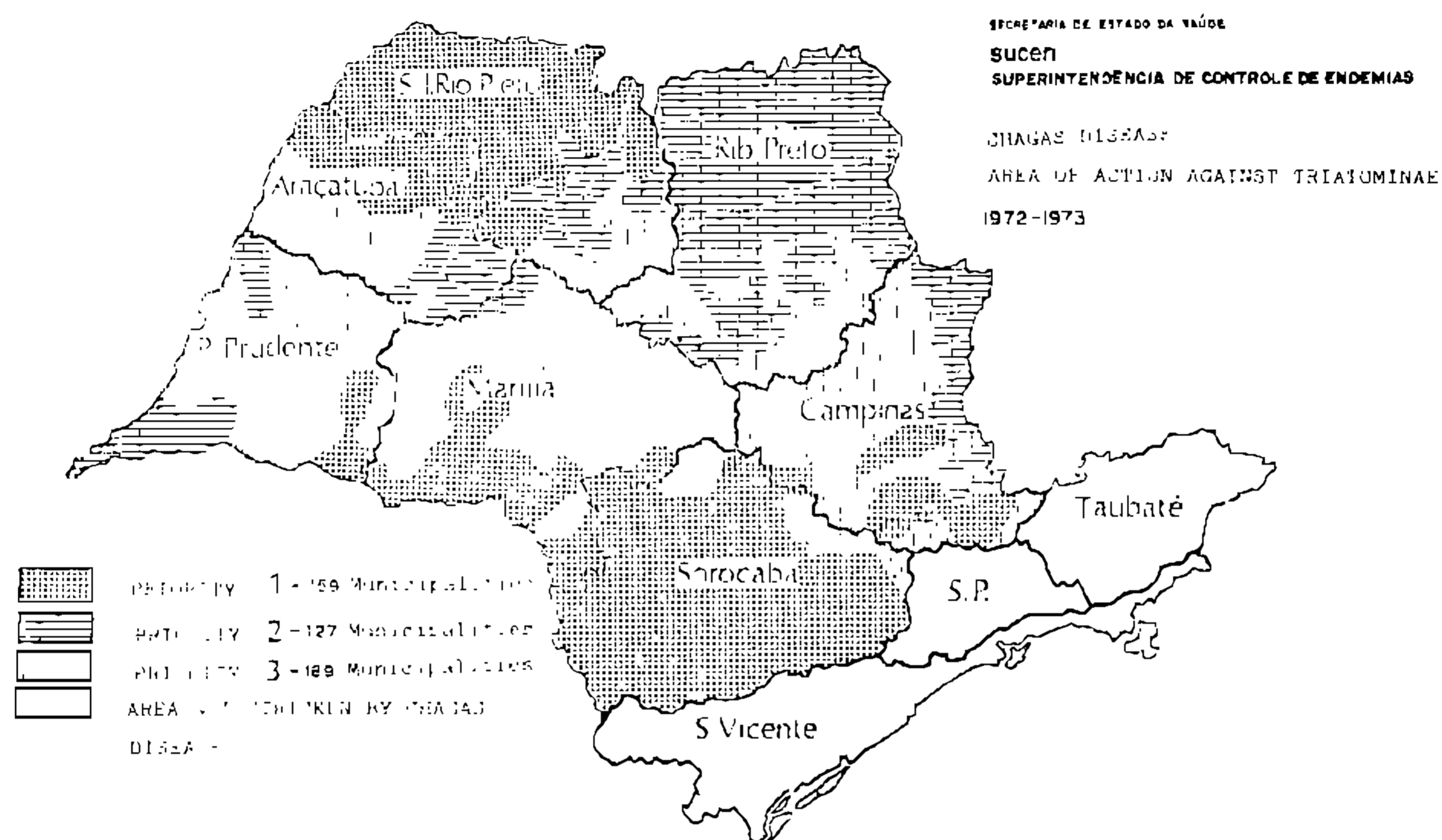
- introduction of the criterium of work based on priority;
- to stimulate people to notify the presence of triatominae;
- to assess the prevalence of chagasic infection.

By taking into account not just the epidemiological factors, but also considering the operational and budgetary aspects, the Municipalities in the infected area were classified in: Priority 1 – those presenting the house bred species – *Triatoma infestans* and that should have all its houses and annexes of the rural and semi-urban zones researched annually; Priority 2 – the Municipalities presenting sylvan and semihouse bred species – *Triatoma sordida* and *Panstrongylus megistus* that should be researched biannually; Priority 3 – the Municipalities which had been showing no sign of any species, that should be researched every 3 years.

In priority 1 Municipalities, whenever there was a suspicion that *T. infestans* might be present in both houses or annexes, the routine research would be complemented by the use of an insectifuge substance – Piriza. Spraying with BHC at 30%, whenever necessary, would also include the neighbouring dwellings as a protective barrier. All triatominae niduses detected were investigated and placed on a follow-up schedule of 90 and 120 days after spraying.

In priority 2 Municipalities, Piriza was not employed and niduses were only revised in cases in which *Trypanosoma cruzi* infected triatominae had been found in inhabited dwellings.

In priority 3 Municipalities, notification of the presence of triatominae in the houses by the public was considered a main activity. The first assesment adopting a Municipality as a unit for studies produced the following classification (Fig. 1):



Priority 1 – 159 Municipalities  
 Priority 2 – 127 Municipalities  
 Priority 3 – 189 Municipalities

The Municipality, when submitted to an assesment, would present informations concerning the activities of triatominae research, clearing of niduses, laboratory data and others, with the intent of clarifying such aspects as: periodicity of the work in Municipalities, its extension and methods employed, the epidemiological situation in neighbouring Municipalities – mainly the adjoining ones.

Criteria used in priority evaluation, when considering the researches undertaken in the last three years, were based on:

- for research inside the dwelling, a locality infestation percentage under 5;
- for research outside dwellings, a locality infestation percentage under 10.

As work according to the methods described above went on, the house infestation rate dropped from 1.02% in 1972 to 0.15% in 1983 and infestation in annexes dropped from 2.16% to 0.82% in the same period of time (Table III).

The decrease in number of visits to houses reflects the progressive reduction of rural dwellings resulting from the economical pattern within the State, which was becoming an urban-industrial one (Dias, 1983).

In 1984, the classification of Municipalities according to priority was (Fig. 2):

Priority 1 – 4 Municipalities  
 Priority 2 – 190 Municipalities  
 Priority 3 – 285 Municipalities

As to triatominae research, shown in Table IV, there were 7,445 individuals of *T. infestans* captured in 1972; this number went on decreasing and by 1983 there were only 25 individuals. As to positivity to *T. cruzi* it has not been recorded since 1979. The decrease in density of infestation by *T. infestans* had already been remarked by Rocha e Silva, Dias Jr. & Guarita (1969). As to *Triatoma sordida*, the number of captured individuals had a slight decrease from 49,352 individuals showing 1.5% of positivity in 1972 to 15,966 with 0.3% in 1983, showing an unsatisfactory response to the usual control methods. But it should be noticed that, although it is getting closer to dwellings, its infection rates have not underwent meaningful

TABLE III

Program for controlling Chagas' disease within the state of São Paulo. Action taken against triatominae by the selective method

Year	Houses				Annexes			
	Researched	Infested	%	Sprayed	Researched	Infested	%	Sprayed
1968	884,812	18,556	2.09	30,326	1,485,299	34,389	2.31	47,785
1969	733,109	17,143	2.33	17,977	1,391,532	36,742	2.64	41,507
1970	639,423	11,585	1.81	16,276	1,060,693	32,907	3.10	74,633
1971	656,796	9,478	1.44	13,332	1,083,822	35,314	3.25	51,655
1972	572,635	5,828	1.02	8,099	1,138,891	24,674	2.16	29,908
1973	562,164	3,752	0.67	5,248	1,082,932	17,625	1.62	19,377
1974	488,311	2,456	0.50	4,160	964,911	15,984	1.66	19,052
1975	457,290	2,187	0.48	3,891	918,014	17,051	1.86	21,099
1976	445,916	1,752	0.39	3,050	900,047	13,720	1.52	17,342
1977	417,909	1,162	0.28	2,169	844,747	9,661	1.14	13,011
1978	459,836	1,076	0.23	2,048	888,457	9,079	1.02	11,695
1979	430,782	760	0.17	1,568	855,991	6,700	0.78	9,013
1980	437,250	711	0.16	1,408	846,317	6,081	0.72	8,469
1981	438,079	808	0.18	1,344	888,442	8,860	1.00	11,203
1982	370,070	638	0.17	1,022	782,558	7,465	0.95	9,848
1983	366,627	532	0.15	951	741,897	6,109	0.82	8,646

Source: SUCEN.

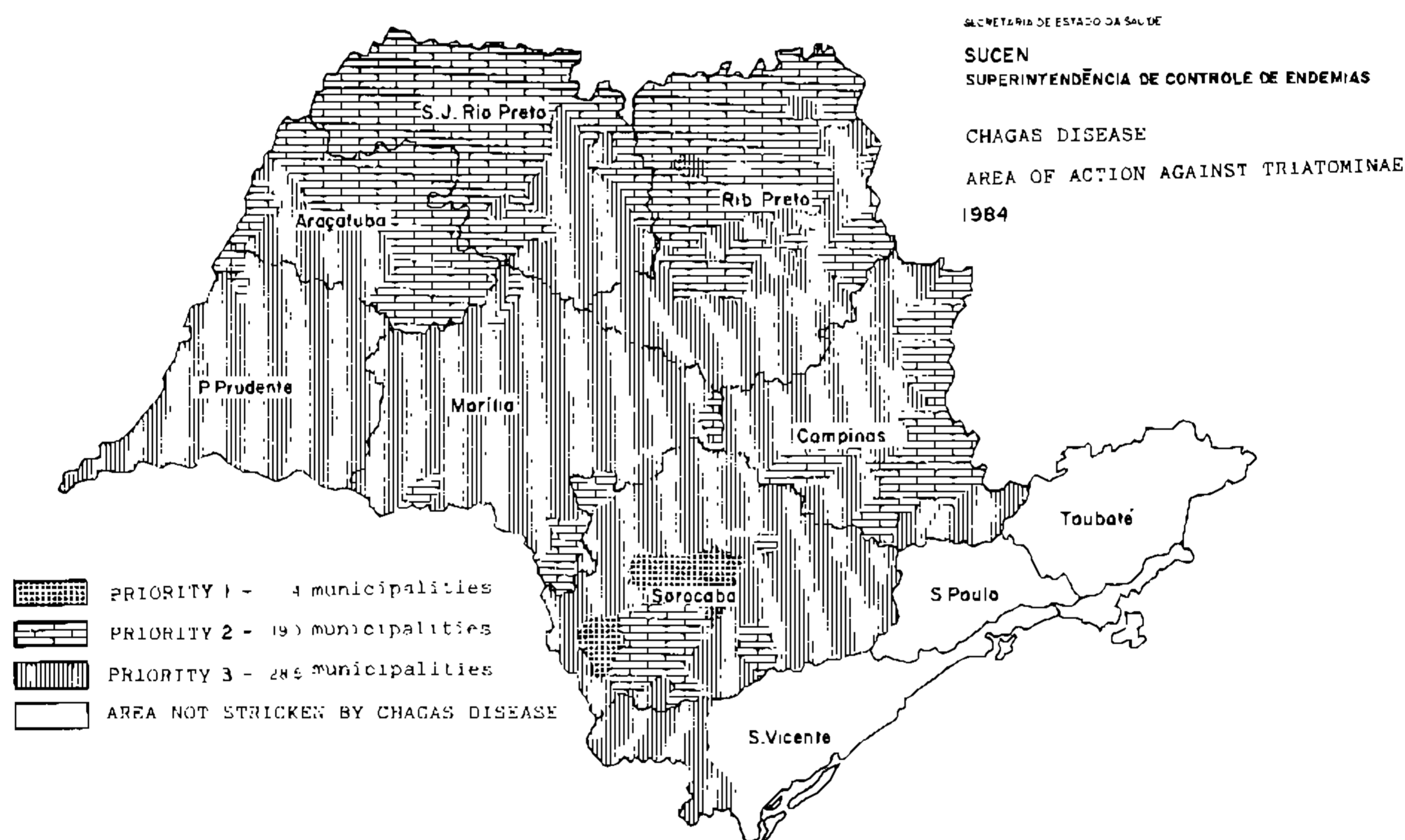


Fig. 2

TABLE IV

Program for controlling Chagas' disease within the state of São Paulo. Action against triatominae according to priorities

Year	<i>T. infestans</i>				<i>T. sordida</i>				<i>P. megistus</i>				Total			
	Capt.	Exam.	Pos.	%	Capt.	Exam.	Pos.	%	Capt.	Exam.	Pos.	%	Capt.	Exam.	Pos.	%
1972	7,445	6,439	187	2.9	49,352	34,023	502	1.5	3,534	3,077	90	3.0	60,331	43,539	779	1.8
1973	4,081	3,249	30	0.9	37,579	27,661	209	1.8	5,839	4,655	259	5.6	47,499	35,565	498	1.4
1974	2,313	1,906	10	0.5	33,285	26,406	187	0.7	9,082	6,225	331	5.3	44,680	34,537	528	1.5
1975	731	575	3	0.5	34,277	26,745	183	0.7	4,069	3,534	349	9.9	39,077	30,854	535	1.7
1976	540	444	2	0.4	28,284	21,917	77	0.3	4,662	4,192	191	4.7	33,436	26,553	270	1.0
1977	370	297	—	—	19,551	16,165	81	0.5	3,992	3,251	262	8.0	23,913	19,713	343	1.7
1978	1,227	1,123	5	0.4	19,048	15,005	41	0.3	2,915	2,508	196	7.8	23,190	18,636	242	1.3
1979	104	89	—	—	14,862	12,973	16	0.1	4,734	3,695	222	6.0	19,700	16,757	238	1.4
1980	32	30	—	—	16,230	14,133	5	0.03	2,782	2,370	613	25.8	19,044	16,533	618	3.7
1981	40	46	—	—	15,523	15,523	14	0.1	1,976	1,976	195	9.8	17,545	17,545	209	1.2
1982	83	83	—	—	20,880	20,880	42	0.2	2,726	2,726	131	4.8	23,689	23,689	173	0.7
1983	25	25	—	—	15,966	15,966	46	0.3	4,345	4,345	689	15.8	20,336	20,336	744	3.6

Source: SUCEN.

alterations (Rocha e Silva, Dias Jr. & Guarita, 1969). On the other hand, Forattini et al. (1979) have demonstrated the persistence of triatominae population, mainly of *T. sordida* which has a high degree of adaptation to dwellings in a region which is being subjected to deep environmental alterations resulting from an intensive agricultural activity. In another paper Forattini et al. (1979) showed that *T. sordida* has a higher survival capacity than *Panstrongylus megistus* as a consequence of its greater production of adults, which raised the supposition that the dispersion activity must be intense. Such observations are valid for the triatominae found in the Southeastern region of Brazil, which corresponds to the Northeastern region of the State of São Paulo.

The other secondary species to be found in the State of São Paulo — *Panstrongylus megistus* — has presented very little change in the number of captured individuals, maintaining an average of 4,200 individuals in the 12 years of research work. In this period of time, the Municipalities presenting this triatominae were located in the Western Side of the Mantiqueira Range and, although classified as Priority 2, were worked annually. In this area, the vertebrates of the *Didelphis* and *Rattus* genera behaved as reservoirs of *Trypanosoma cruzi*, being frequently found inside dwellings, but mainly in abandoned ones, its annexes and peripheral areas (Rocha e Silva, Andrade & Lima, 1975). The presence of infected individuals of *P. megistus* has been observed in these reservoirs, which are the main source for the said species, thus corroborating the high percentage of positivity found in the captured individuals.

Concluding, there are four epidemiological situations recognized in the State as to risk of natural transmission of Chagas' disease:

1. areas having residual niduses of *T. infestans* in parts of the Sorocaba Administrative Region, with a low number of individuals;
2. areas of *Triatoma sordida*, with considerable activity on the human ecotype, including most Municipalities of the Administrative Regions of Ribeirão Preto, São José do Rio Preto and Araçatuba, having an insignificant number of infection by *T. cruzi* and a marked feeding preference for birds;
3. areas of *Panstrongylus megistus* either established in or sporadically entering dwellings and annexes in the Northern part of the Administrative Region of Campinas and the Vale do Ribeira Region;
4. areas showing sporadic occurrence of triatominae of various species, generally introduced by means of passive transportation or else originating in residual niduses having little meaning.

The Sorocaba Region, mainly the micro-region of Campos de Itapetininga, is the only area in the State to have residual niduses of *T. infestans* coinciding with the fact that this region has been undergoing a slower economical transformation. The presence of these niduses is due to the high number of human dwellings presenting conditions which are favorable to resettlement.

In regions of *T. sordida* occurrence, it has been shown that the species presents a certain degree of settlement in human dwellings, although it concentrates on annexes; in house interiors it has a low but constant density (5% in houses and 95% in annexes). Considering that there is some doubt as to its efficiency as an endemic transmitter, most authors agree in that this triatominae should be kept under control in dwellings. Still, an up-to-date assesment should be undertaken, trying to use existing resources to establish the maximum safe intervals between visits to houses.

The areas presenting *P. megistus* occurrence, on one hand are a cause for concern because of the vectorial capacity of the species, which has been sufficiently proved in other regions of the country; on the other hand they have shown that entomological surveillance based on community participation has proved to be more efficient in discovering nidi than routine research in houses. Both in the Campinas region, where people are familiar with house bred triatominae and in the Vale do Ribeira region, where people practically ignore the problem, the stimulus to search for triatominae is being exercised by the health centers or by the rural school network, producing very satisfactory results. However, it has been demonstrated that in both situations it is required that attention to notices should be immediate; a careful research of nidus amplitude and its destruction whenever necessary is the only way to maintain a high degree of responsiveness in people, as well as of assuring that the area is kept under control.

In 1983 the activity of compliance to notification of triatominae by dwellers showed that 69.3% of the Municipalities presenting notices were positive to triatominae. Although this percentage is slightly lower than the one obtained in routine inspection activity, (72.5% per Municipality) it was verified that 12.4% of the houses researched because of notification were positive, versus 0.14% in routine research; 3.63% of annexes with notification were positive, versus 0.82% in routine procedures. This data shows the efficacy of the activity (Wanderley et al., 1984). In the areas presenting sporadic occurrences of triatominae, it is believed that by fostering surveillance activities of the pattern already described, it will be possible to decrease the number of routine inspections performed by fieldwork teams to an average 3-year interval.

As to prevalence of chagasic infection, one of the assesment methods which allows for the measurement of control work efficacy is based on serological inquiries by means of indirect immunofluorescence (Cerisola, 1969). Based on a previous inquiry, Guarita et al. (1978) performed a longitudinal study of schoolchildren attending the 1st year of junior school in the State of São Paulo from 1973 to 1983.

Its methodology and partial results were presented by Guarita et al. (1982). After 11 years of study it was possible to verify that chagasic infection within the group went gradually decreasing to reach extremely low levels which show a tendency to become nil (Fig. 3).

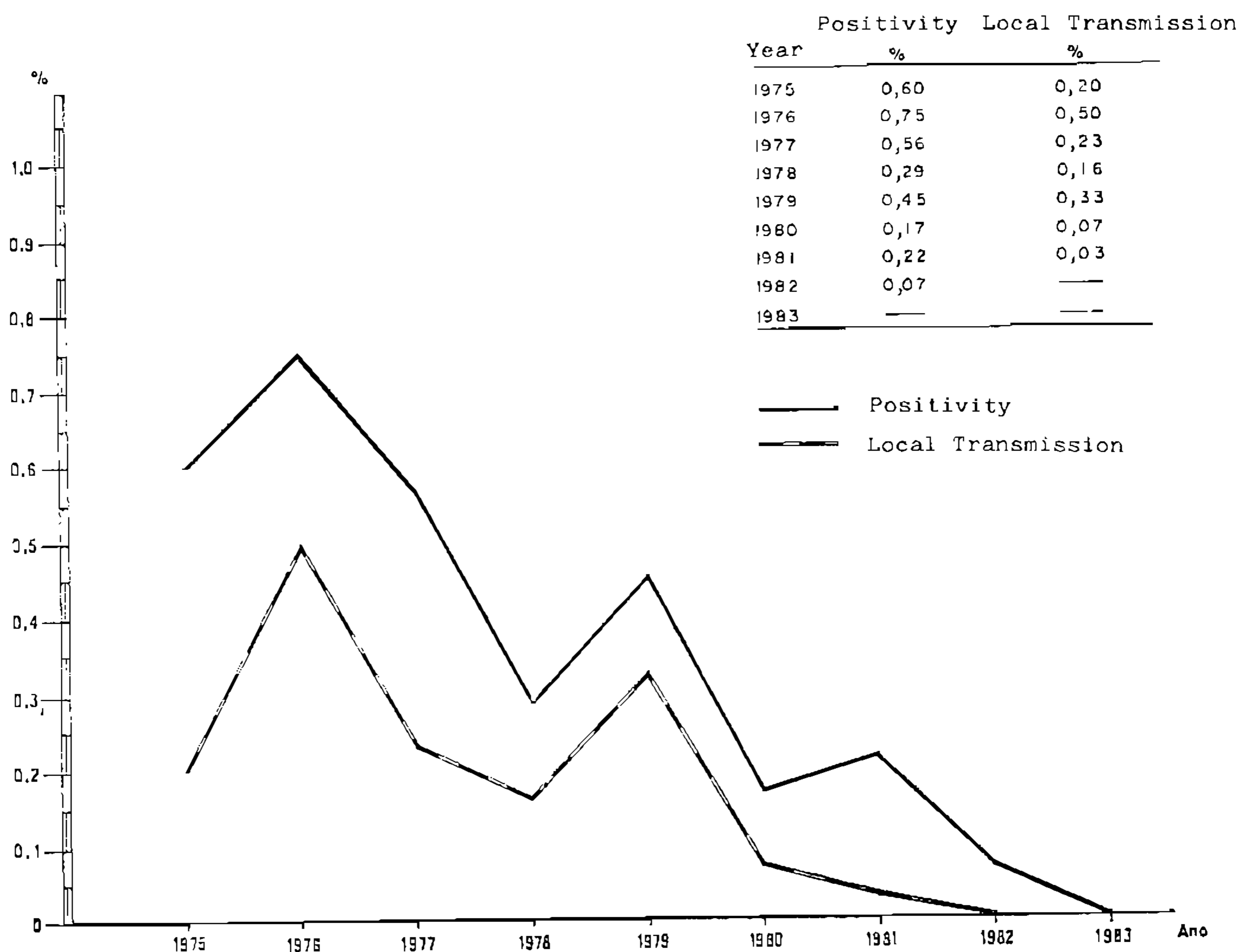


Fig. 3: Serological Inquest in Schoolchildren through RIFI in the State of São Paulo, from 1975 to 1983.

### Surveillance Improvement and Perspectives

Considering the present situation of the Program in the State, as from 1985 some measures will be implemented which aim at improving the surveillance activity for Chagas' disease, so as to assure the results already reached and to increase the efficiency of the control actions. The measures are:

1. To keep the bases of the Control Program regarding priorities, but changing the work interval from 3 to 4 years in Priority 3 areas.
2. To schedule field activities in Priority 2 and 3 so that the routine research coincides with the time there is a greater dispersion of species.
3. To take the locality instead of the Municipality as a work unit.
4. In field operations, to consider attention to notices as a priority.
5. To educate dwellers as to the informations that allow for the finding of triatominae niduses.
6. To test all triatominae which are examined in the State for precipitin reaction, so as to investigate their source of food.
7. To use RIFI as part of the nidus investigation by collecting a blood sample from dwellers wherever the following are found:
  - presence of *T. infestans*;
  - presence of one individual of any species showing precipitin reaction to human blood, independently of the place it was captured in;
  - presence of an individual of any species which is positive to *T. cruzi* inside a dwelling.
8. To investigate and implement the use of more efficient insecticides for controlling *Triatoma sordida* and *Panstrongylus megistus*.

According to what has been stated here, SUCEN is at present faced with a dilemma: if the natural transmission of Chagas' disease in the rural zones of the State is a problem which has been sized, the magnitude of the endemic disease in urban centers has not been established yet. Considering the high urbanization

rates and the intense migration occurring within the State in the last decades we believe that the illness must be undergoing an urbanization process enhanced by the flow of a great mass of infection sources towards urban centers.

Within this process there are two main facts to be considered: the transmission by means of blood transfusions and the individual struck by Chagas' disease. Transmission by transfusion is basically tied to unemployment, to professional donors to profit-aimed blood banks, to omission in transfusional accidents, to the non-diagnosing of the donor, and to lack of preventive measures.

As from 1985 it is intended to do every possible effort to implement sanitary control measures within the State that will effectively deal with the problem.

As to complying to the needs of the Chagas' disease patient, there is no State program with this specific purpose, in spite of the high demand for such a service, of its importance within the universe of medical services to be provided for the population and of its implications in the surveillance of the disease.

SUCEN is striving to, based on the knowledge it has acquired about the endemic disease within the State and on interchange between the other health services, organize a structure that will see to the needs of the Chagas' disease patient, as the basic network of health services within the State and Municipalities is being improved to provide all encompassing services to the public.

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