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SMR.940 - 40

THIRD AUTUMN WORKSHOP ON MATHEMATICAL ECOLOGY

(14 October - 1 November 1996)

"Assessing community risk of Chagas disease"

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These are preliminary lecture notes, intended only for distribution to participants.

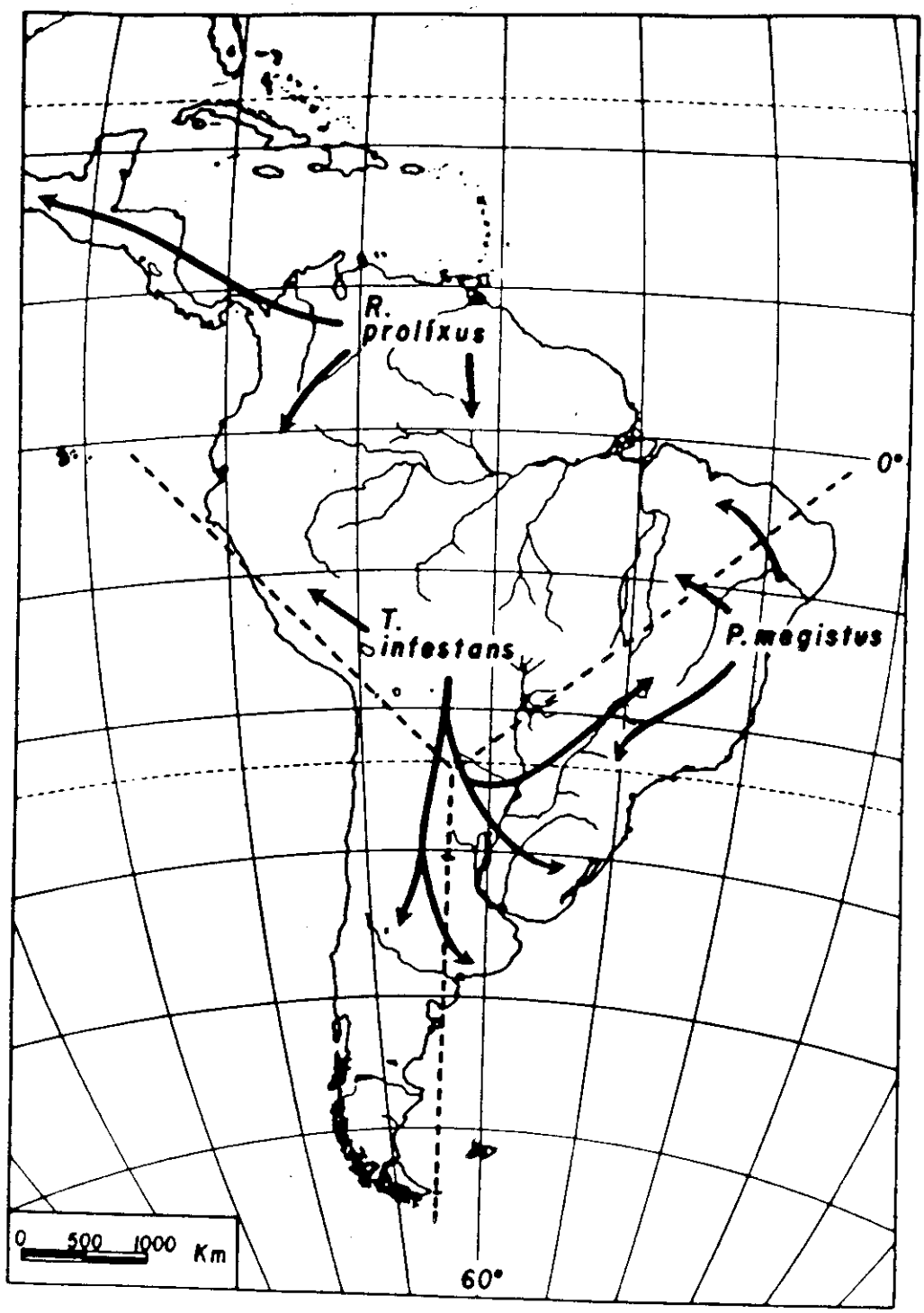


FIGURE 5. Domiciliarity dispersion of *P. megistus*. *R. prolixus*, and *T. infestans* associated with open lands represented by the dotted Y-profile (see Figure 1).

FIGURE 3. A moulting adult *T. infestans* on the bedroom wall of a densely infested house (Jaguarinha, State of Minas Gerais, Brazil).

TABLE 1. PREVALENCE OF *TRYPANOSOMA CRUZI* INFECTION IN ARGENTINA, BY AGE GROUP, LOCALITY AND TREATMENT WITH INSECTICIDE TO CONTROL *TRIATOMA INFESTANS*. 1983-1988.

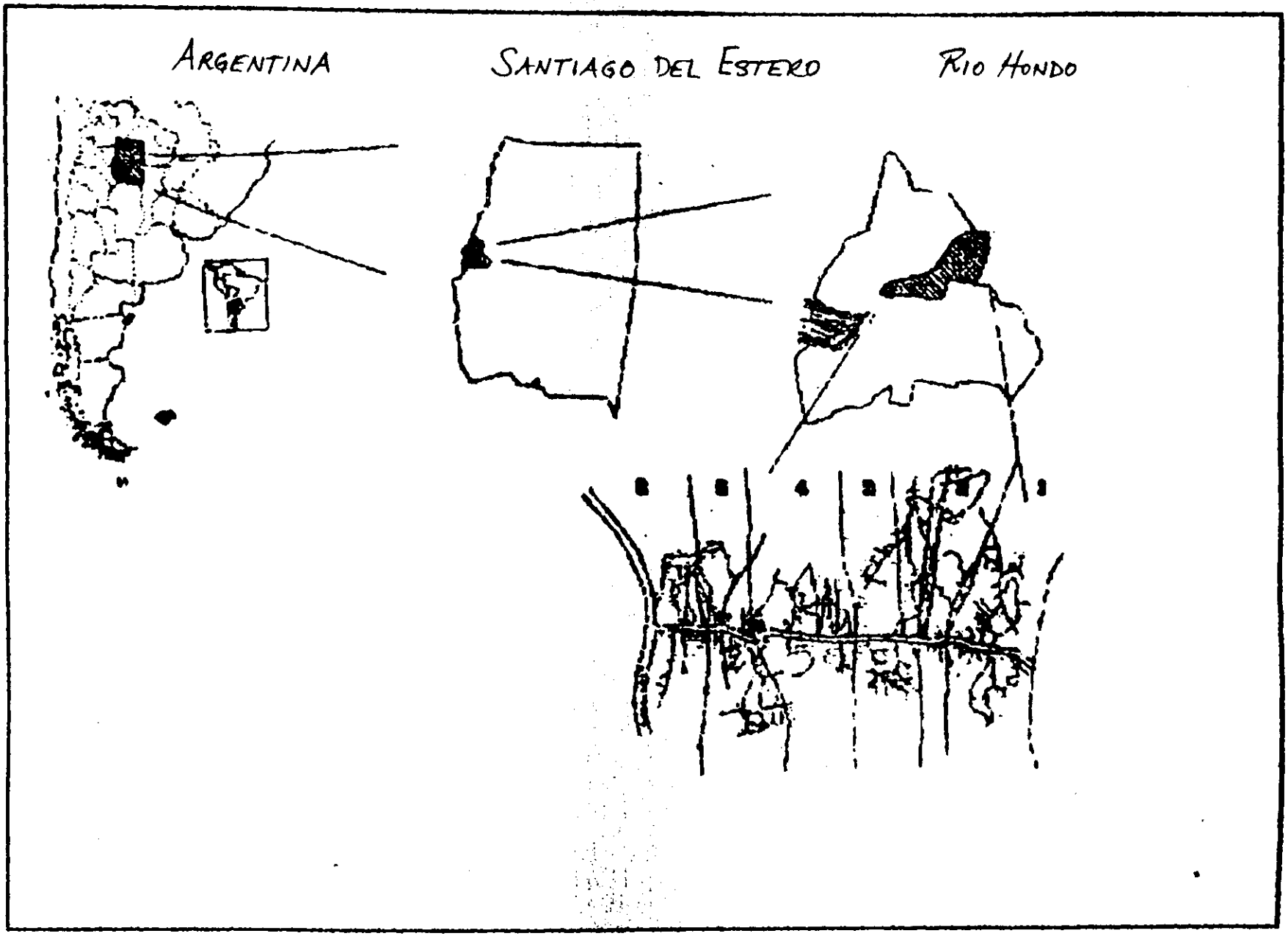
		AGE GROUP				
		0-4	5-9	10-14	15-19	> 20
LOCALITIES		%POS.+	%POS.+	%POS.+	%POS.+	%POS.+
Santa Victoria	(*)	26.6	46.03	48.50	35.00	ND
Caldén-Retamo	(*)	9.52	22.22	33.33	33.33	29.88
San Martín 2	(*)	22.9	40.00	55.90	24.07	42.85
El Mistol	(*)	10.00	34.78	41.17	46.10	60.00
Amamá	(*)	13.04	24.24	47.72	48.48	44.44
Botelos	(*)	22.20	42.10	44.44	46.00	54.45
Chancaní	(**)	2.86	23.08	45.80	52.17	56.45
Cavi Chico	(**)	0.00	0.00	0.00	0.00	19.04
Lobatón	(**)	2.77	5.40	6.25	17.64	54.54
Villa Ocampo	(**)	0.00	1.25	2.05	6.66	5.29
Pirquitas	(**)	5.00	19.20	20.00	21.42	16.00
Paclín	(**)	0.00	0.00	0.00	0.00	37.50
Pajonal	(**)	5.70	12.06	8.82	ND	27.02
San Martín 1	(**)	0.00	20.83	21.42	23.07	18.42

ND: No data

(*) Without insecticidal treatment

(**) With insecticidal treatment

(+) Positive based on results of serologic tests


ARGENTINA
SANTIAGO DEL ESTERO
RIO HONDO

GRADE OF MEMBERSHIP (GOM) MODELS

Let $\underset{=}{X} = (X_1, \ldots, X_J)$ be a discrete response vector and $\underset{\sim}{g} = (g_1, \ldots, g_K)$, where $g_i \geq 0$, $\sum_{i=1}^{K} g_i = 1$ be a random vector taking values in the unit simplex with K-vertices.

Define

$$P\left(\underset{=}{X} = \underset{=}{l}\right) = \int_{\mathcal{S}_K} P\left(\underset{=}{X} = \underset{=}{l} \,\middle|\, \underset{\sim}{g} = \underset{\sim}{\gamma}\right) d\mu(\underset{\sim}{\gamma})$$

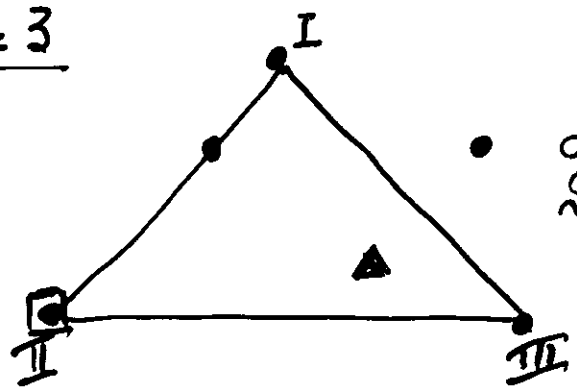
Assume:

$$P\left(\underset{=}{X} = \underset{=}{l} \,\middle|\, \underset{\sim}{g} = \underset{\sim}{\gamma}\right) = \prod_{j=1}^{J} P\left(X_j = l_j \,\middle|\, \underset{\sim}{g} = \underset{\sim}{\gamma}\right)$$

AND

$$P\left(X_j = l_j \,\middle|\, \underset{\sim}{g} = \underset{\sim}{\gamma}\right) = \sum_{k=1}^{K} \gamma_k \underbrace{P\left[Y_j^{(k)} = l_j\right]}_{\text{Profile probabilities.}}$$

$K = 3$



• $\underset{\sim}{g} = \left(\frac{2}{3}, \frac{1}{3}, 0\right)$

▲ $\underset{\sim}{g} = \left(\frac{1}{6}, \frac{1}{6}, \frac{2}{3}\right)$

□ $\underset{\sim}{g} = (0, 1, 0)$

Let $\underset{\sim}{X} = (\underset{\sim}{X}_1, \underset{\sim}{X}_2)$ and $\underset{\sim}{g} = (\underset{\sim}{g}_1, \underset{\sim}{g}_2)$ be random vectors defined on a common probability space.

$$\underset{\sim}{X}_1 = (X_{1,1}, \ldots, X_{1,J_1})$$
$$\underset{\sim}{X}_2 = (X_{2,1}, \ldots, X_{2,J_2})$$

$\underset{\sim}{g}_1 = (g_{1,1}, \ldots g_{1,K_1})$ and $\underset{\sim}{g}_2 = (g_{2,1}, \ldots, g_{2,K_2})$

$g_{\nu,k} \geq 0$ and $\sum_{k=1}^{K_\nu} g_{\nu,k} = 1$

$$P(\underset{\sim}{X}_\nu = \underset{\sim}{l}_\nu \mid \underset{\sim}{g}_\nu = \underset{\sim}{\gamma}_\nu) = \prod_{j=1}^{J_\nu} P[X_{\nu,j} = l_{\nu,j} \mid \underset{\sim}{g} = \underset{\sim}{\gamma}_\nu]$$

for $\nu = 1,2$

$$P(X_{\nu,j} = l_\nu \mid \underset{\sim}{g}_\nu = \underset{\sim}{\gamma}_\nu) = \sum_{k=1}^{K_\nu} \gamma_{\nu,k} P[Y_{\nu,j}^{(k)} = l_{\nu,j}]$$

Profile probabilities for domain ν, $\nu = 1,2$.

$\underset{\sim}{X}_1$ = Blood Index Variables

dogs
cats
people
people/room
people/# beds

people/# structures
people + # dogs + # cats
[# people + # dogs + # cats]/# rooms
[# people + # dogs + # cats]/# beds
[# people + # dogs + # cats]/# structures

$\underset{\sim}{X}_2$ = Environmental Variables

Quality of inner roof
" " inner walls
" " Gallery roof
rooms
beds

Presence of Corn storage area/container
" " Kitchen
" " waste deposit area
" " corral
" " pen for pigs
" " pile of bricks

PROBABILITY OF INFECTION WITH TRYPANOSOMA CRUZI OF THE VECTOR TRIATOMA INFESTANS FED ON INFECTED HUMANS AND DOGS

R.E. Gurtler, J.E. Cohen, R.L. Chuit, E.L. Segura, et. al.

— Infectivity to Bugs of Seropositive dogs was 12 x higher than that of seropositive children and 100x higher than that of seropositive adults

Prob. of infection of an uninfected bug fed randomly on any dog = 0.3082

Prob of infection of an uninfected bug fed randomly on any human = 0.0062

PROFILE DESCRIPTIONS

BLOOD INDEX CONDITIONS

High Risk = [>2 Dogs] AND [>2 cats]
AND {[# people + # Dogs + # Cats / # rooms] > 6}
AND {[# people + # Dogs + # Cats] / # structures] > 3}

LOW RISK = No Adverse index values

ENVIRONMENTAL FACTORS

High Risk = [Bad inner roof] AND [Bad Gallery roof]
AND [Corn storage area present]
AND [pig pen present] AND [Pile of Bricks]

LOW RISK = No Adverse Environmental Conditions

Table 5.4 Sero-positivity rates by habitat risk

Variable Type	Environmental Variables $-g^{(2)}_1$			
	Risk	Low-1	Med-2	High-3
Blood variables $-g^{(1)}_1$	Low-1	0.188	0.162	0.214
	Med-2	0.205	0.22	0.09
	High-3	0.193	0.228	0.259

CHAGAS' DISEASE RISK CATEGORIES

Prevalence

Low Risk =
- No external food storage area
- # of peridomiciliary structures = 1
- # Dogs + # Cats = 1

7.69%

High Risk =
- external food storage area
- # of peridomiciliary structures > 2
- # Dogs + # cats > 1

36.4%