

Research Article / Artículo de Investigación

Spontaneous colonization of *Panstrongylus megistus* (Burmeister, 1835) (Hemiptera: Reduviidae) in an experimental chicken coop: A potential k-strategist species?

Colonización espontánea de *Panstrongylus megistus* (Burmeister, 1835) (Hemiptera: Reduviidae) en un gallinero experimental: ¿Una especie potencialmente estratega-K?

Walter Ceretti-Junior¹ , Gabriel Zorello Laporta² , João Aristeu da Rosa³ , Jociel Kleyton Santos Santana³ , Jose Maria Soares Barata^{1†} , Mauro Toledo Marrelli¹ , Jader de Oliveira^{3,4*} 

¹Departamento de Epidemiologia, Faculdade de Saúde Pública, Universidade de São Paulo, São Paulo-SP, Brasil. ²Programa de Pós-graduação em Ciências da Saúde, Centro Universitário FMABC, Santo André, SP, Brasil. ³Universidade Estadual Paulista (Unesp) Faculdade de Ciências Farmacêuticas, Araraquara, SP, Brasil. ⁴Department of Entomology, National Museum of Natural History, Smithsonian Institution, Washington, D.C., USA. [†] Author name passed away. The authors dedicate this work to their memory, in recognition of their valuable scientific and personal contributions. ✉ jader.oliveira@unesp.br*

ZooBank: urn:lsid:zoobank.org:pub:6BDDCBC1-38FE-4E93-827D-D464DD6979AA
<https://doi.org/10.35249/rche.51.4.25.06>

Abstract. Vector-borne transmission by blood-feeding triatomine insects remains the main route of Chagas disease infection. These insects are becoming increasingly common in urban environments. Spontaneous domiciliation of *Panstrongylus megistus* (Burmeister, 1835) (Hemiptera: Reduviidae) in experimental chicken coop: a possible K-strategist species. A study of population dynamics was carried out on a population of *P. megistus* that spontaneously colonized the experimental chicken coop (ECC) in a rural area from 1998 to 2002. The mark-release-recapture method was applied on *P. megistus* specimens in various developmental stages. Frequency distributions were analyzed using the Kiritani-Nakasuji method. The colonizer population ranged from 19 to 208 specimens, the development cycle from nymph I to adult lasted 540 days, and the total (K) and daily (S) survival rates were 0.2573 and 0.9975, respectively. The ECC was an important tool for population and surveillance studies. The colony in the ECC, an artificial ecotope, was stable, suggesting epidemiological importance in maintaining enzootic cycles of *Trypanosoma cruzi* and other trypanosomatids. The life cycle and survival rate suggest this species may be a K-strategist.

Key words: Ecology; Chagas disease; surveillance; vectors.

Resumen. La transmisión vectorial por insectos triatominos hematófagos sigue siendo la principal vía de infección de la enfermedad de Chagas. Estos insectos son cada vez más comunes en ambientes urbanos. Domiciliación espontánea de *Panstrongylus megistus* (Burmeister, 1835) (Hemiptera: Reduviidae) en un gallinero experimental: ¿una posible especie estratega-K? Se realizó un estudio de dinámica poblacional en una población de *P. megistus* que colonizó espontáneamente el gallinero experimental (GE) en una zona rural entre 1998 y 2002. Se aplicó el método de marcaje-liberación-recaptura en ejemplares de *P. megistus* en diferentes estadios de desarrollo. Las distribuciones de frecuencia se analizaron mediante el método de Kiritani-Nakasuji. La población colonizadora varió de 19 a 208 ejemplares, el ciclo de desarrollo desde ninfa I hasta adulto duró 540 días, y las tasas

Received 12 September 2025 / Accepted 13 November 2025 / Published online 2 December 2025

Responsible Editor: José Mondaca E.

de supervivencia total (K) y diaria (S) fueron de 0,2573 y 0,9975, respectivamente. El GE fue una herramienta importante para estudios de población y vigilancia. La colonia en el GE, un ecótopo artificial, fue estable, lo que sugiere una importancia epidemiológica en el mantenimiento de ciclos enzoóticos de *Trypanosoma cruzi* y otros tripanosomátidos. El ciclo de vida y la tasa de supervivencia sugieren que esta especie puede ser una estrategia-K.

Palabras clave: Colonización; ecología; enfermedad de Chagas; vigilancia; vectores.

Introduction

Panstrongylus megistus (Burmeister, 1835) was the first vector found to be infected with *Trypanosoma cruzi* since the protozoan's initial description, as well as with the entire epidemiological chain of Chagas disease subsequently identified (Chagas 1909). This triatomine species is native to vast regions of Argentina, Bolivia, Brazil, Paraguay, and Uruguay (Melo *et al.* 2023). The centers of endemism and dispersal of *P. megistus* correspond to areas currently located in the states of Rio de Janeiro, Bahia, and Pernambuco, where the Atlantic Tropical system predominates—composed of subdeciduous tropical forests and evergreen hygrophilous forests (Lent & Wygodzinsky 1979; Forattini 1980). Its current distribution in Brazil includes the states of Acre, Alagoas, Bahia, Ceará, Distrito Federal, Espírito Santo, Goiás, Maranhão, Mato Grosso, Mato Grosso do Sul, Minas Gerais, Pará, Paraíba, Paraná, Pernambuco, Piauí, Rio de Janeiro, Rio Grande do Norte, Rio Grande do Sul, Rondônia, Santa Catarina, São Paulo, Sergipe, and Tocantins (Galvão *et al.* 2024).

Panstrongylus megistus was predominantly sylvatic in preserved environments, occupying natural ecotopes such as mammal burrows and bird nests (Santos Jr. 2013). However, in regions heavily modified by agricultural and livestock activities such as the state of São Paulo and large areas in the Northeast and Central-West regions it began exhibiting a high degree of synanthropy, being frequently recorded both indoors and in peridomestic settings (Favoretto *et al.* 2013). The importance of *P. megistus* as a vector of Chagas disease in Brazil has changed significantly over time. From being the main domestic vector at a national level until the 1930s, it was supplanted by *Triatoma infestans* (Klug, 1834). However, with the elimination of the latter, it has regained its status as the primary vector, albeit on a regional scale. It is now considered the main domestic vector in the central, eastern, and southeastern regions of Brazil (Patterson *et al.* 2009; Ribeiro Castro *et al.* 2018), feeding on the blood of mammals such as rodents, opossums, and humans (Lent & Wygodzinsky 1979; Pires *et al.* 2002).

According to Forattini (1980), there are essentially two epidemiologically distinct strains of *P. megistus*. One occurs in the Brazilian Central Plateau, extending from Paraná to the Northeast, where the vector is domiciliated and thus plays a major role in Chagas disease transmission. The other occurs in the Serra do Mar system, where the insect remains sylvatic, inhabiting various natural ecotopes such as rodent burrows and bird nests.

Since the 1990s, this species has been found in artificial ecotopes in areas where domiciliation had not been previously recorded (Steindel *et al.* 1994; Nascimento *et al.* 1997; Guilherme *et al.* 2001; Damborsky *et al.* 2001). Silveira & Vinhaes (1999) noted that following the eradication of *T. infestans* from human dwellings, *P. megistus*, along with *Rhodnius neglectus* Lent, 1954, *Triatoma sordida* Stål, 1859, and *Triatoma brasiliensis* Neiva, 1911, among others, became increasingly frequent in these ecotopes, thereby warranting greater attention from entomological surveillance authorities.

K-strategist species are typically those that evolve in relatively stable, saturated environments where populations approach the environment's carrying capacity (K). These species characteristically mature later, produce fewer offspring, invest more heavily in each

offspring (e.g., longer developmental time, parental care), and are competitively efficient under high density and resource limitation. The emphasis of selection is on traits that maximise survival and competitive ability, rather than rapid population increase (Boyce 1984; Travis *et al.* 2023).

According to Monroy *et al.* (2003), the experimental chicken coop (EC) systematized by Forattini *et al.* (1973) remains a valuable tool for ecological studies and for monitoring sylvatic triatomine populations with synanthropic tendencies, as it allows for observations of behavior and population dynamics, making it useful for entomological surveillance programs. This study aimed to investigate the population dynamics, development cycle, and survival rates of a *P. megistus* colony that spontaneously domiciled in an experimental chicken coop, in order to assess the epidemiological importance of this artificial ecotope in maintaining enzootic cycles of *Trypanosoma cruzi* and the species' ecological traits as a potential K-strategist.

Materials and Methods

Study period: Between November 1998 and March 2002, ten inspections were conducted in the experimental chicken coop (EC) at regular intervals of approximately 4 to 6 months. **Study Area:** The study was conducted at Sítio Carandá, municipality of Araraquara, São Paulo, Brazil (21°47'37" S; 48°10'52" W) (Figs. 1A, B). The region presents average annual temperature of 22 °C and relative humidity of 75%. A remnant of closed subdeciduous tropical forest is located adjacent to a modified area. **Experimental chicken Coop:** A portable experimental chicken coop (Fig. 1C), following the design proposed by Forattini *et al.* (1973), was installed between the forest remnant and the modified environment. Three domestic fowl were kept inside the EC, serving as attractants and blood sources for triatomines. No artificial control of temperature or humidity was implemented inside the EC. **Collection and marking of triatomines:** During each inspection, thatch and bricks were removed and examined to assess the *P. megistus* population (Fig. 2). All collected individuals were taken to the laboratory, counted, and marked with acrylic paint on the pronotum and tibia—following Forattini *et al.* (1977)—to enable individual recognition and developmental stage assessment. Marked insects were subsequently returned to the EC. **Population assessment and survival rate analysis:** The developmental cycle duration, daily survival rate at each instar, and overall colony survival (Fig. 2) were estimated based on frequency distribution analysis of individuals by developmental stage, following the Kiritani-Nakasuji method as described by Forattini *et al.* (1977). At each census (T), the population median instar (E) was determined from stage frequency distributions. **Data Analysis:** Frequency distribution analyses were performed to estimate instar duration and survival rates, allowing inference of population dynamics over time.

Results and Discussion

The colony of *Panstrongylus megistus* became established in the sixth month following the installation of the experimental chicken coop (EC), with the population size ranging from 19 to 208 individuals across different sampling events. Seasonal fluctuations in population density were observed, with the highest density recorded during the summer. This pattern indicates that microclimatic factors, such as temperature and humidity, directly influence the reproduction and development of these insects. The maximum number of individuals observed (208) was lower than that reported in previous studies (Forattini *et al.* 1979, 1984), suggesting a possible influence of intensified agricultural activity, which reduces residual forest areas and is likely associated with the decline of wild *P. megistus* populations in the region.

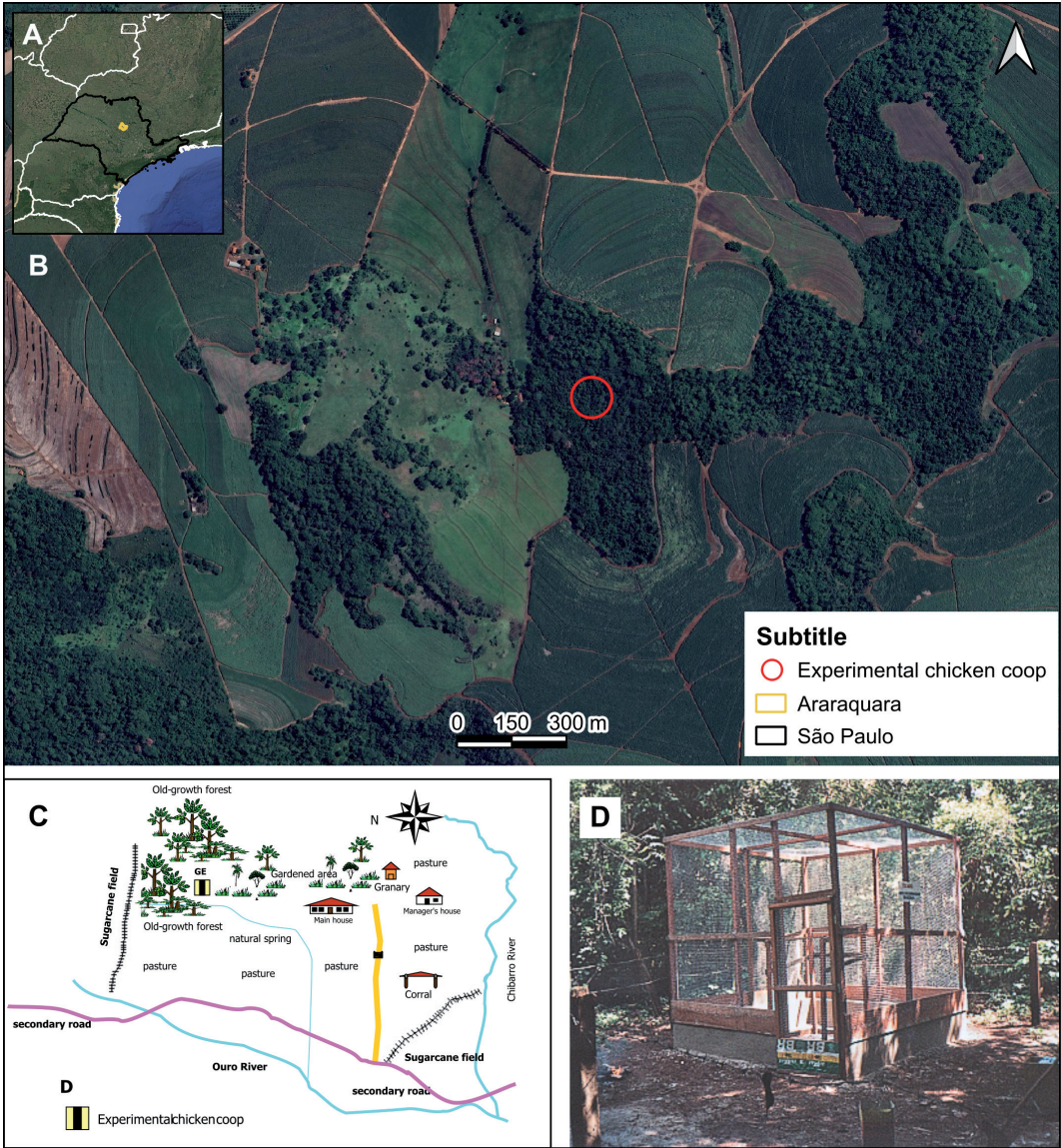


Figure 1. Study area and installation of the experimental chicken coop for triatomines. **A.** Location of the municipality of Araraquara in the state of São Paulo, Brazil. **B.** Satellite image of the study area. **C.** Schematic diagram illustrating the layout of the environment. **D.** Experimental chicken coop installed in a forest fragment, used as a shelter for *Panstrongylus megistus*. / **Figura 1.** Área de estudio e instalación del gallinero experimental para triatomíneos. **A.** Ubicación del municipio de Araraquara en el estado de São Paulo, Brasil. **B.** Imagen satelital del área de estudio. **C.** Diagrama esquemático que ilustra la disposición del entorno. **D.** Gallinero experimental instalado en un fragmento de bosque, utilizado como refugio para *Panstrongylus megistus*.

The life cycle of *P. megistus* was found to be prolonged, with a nymphal period lasting 540 days. This value is similar to that reported by Heitzmann-Fontenelle (1976, 1980/1981) under laboratory conditions (565-608 days) but exceeds the duration recorded by Forattini *et al.* (1978) under similar field conditions, which did not surpass 415 days. This discrepancy suggests that specific, local microclimatic factors significantly influence the developmental

timeline of this species. Furthermore, the colony demonstrated remarkable survival in the artificial ecotope. The calculated total survival rate per instar ($K = 0.2573$) indicates that for every 100 first-instar nymphs, approximately 26 may reach adulthood, supported by a high mean daily survival rate per instar ($S = 0.9975$). These high survival rates are a key characteristic of a K-selected reproductive strategy (Tab. 1).

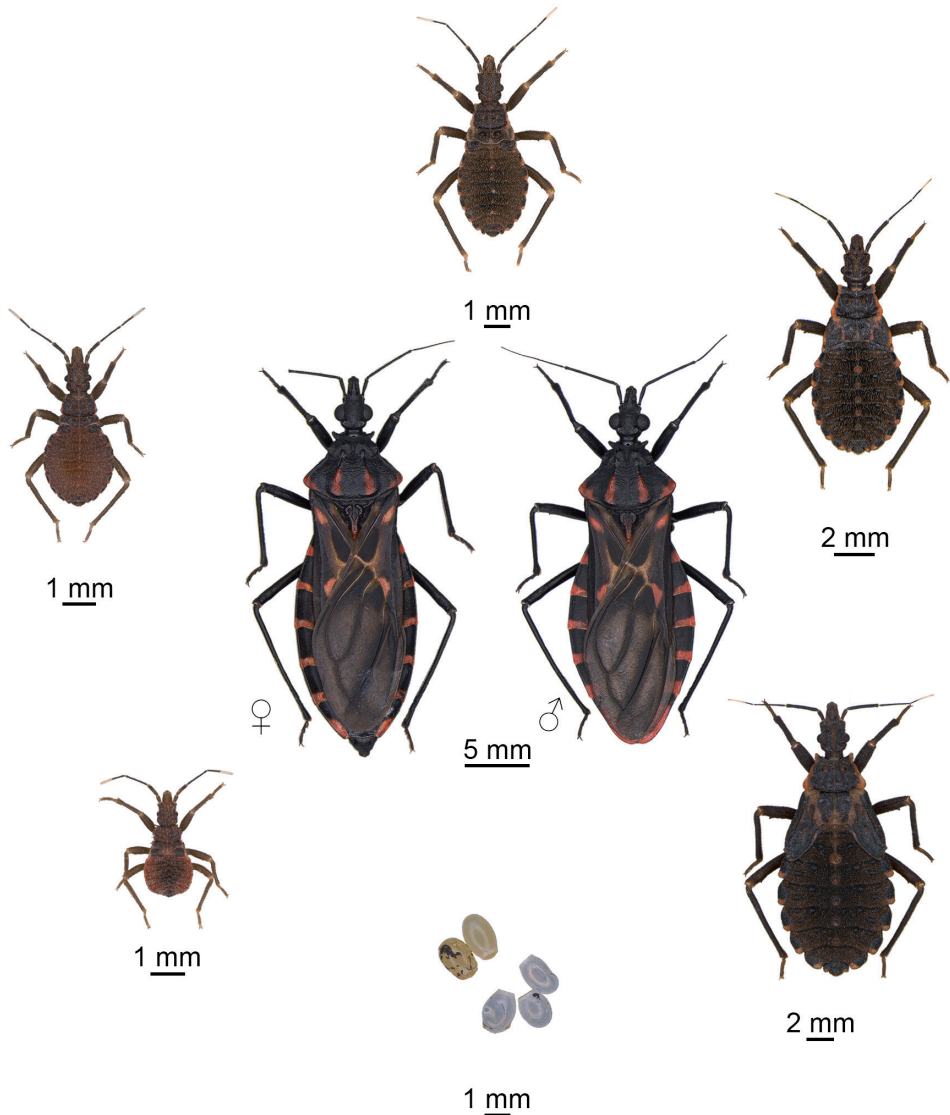


Figure 2. Example of the life cycle of *Panstrongylus megistus*, showing the different developmental stages: egg, first- to fifth-instar nymphs (N1 to N5), and adults (male and female). / **Figura 2.** Ejemplo del ciclo de vida de *Panstrongylus megistus*, mostrando los diferentes estadios de desarrollo: huevo, ninfas de primer a quinto estadio (N1 a N5) y adultos (macho y hembra).

Table 1. Duration of instars in days (ai), survival at each instar (Si = daily survival within each instar and Ki = total survival of each instar), and NS = number of survivors at the beginning of each instar of *P. megistus*, in the experimental chicken coop at sitio Carandá, Araraquara-SP, from November 1998 to March 2002. / **Tabla 1.** Duración de los estadios ninfales en días (ai), supervivencia en cada estadio (Si = supervivencia diaria dentro de cada estadio y Ki = supervivencia total de cada estadio), y NS = número de individuos supervivientes al inicio de cada estadio de *P. megistus*, en el gallinero experimental en el sitio Carandá, Araraquara-SP, de noviembre 1998 a marzo de 2002.

Instar	Duration (ai)	Survival		li =NS
		Si = SD	Ki = ST	
I	24	0.9980	0.9542	100
II	81	0.9982	0.8635	95
III	288	0.9990	0.7522	82
IV	93	0.9969	0.7478	62
V	54	0.9892	0.5553	46
Total	a = 540	S = 0.9975	K = 0.2573	l = 26

The interpretation of these findings, particularly from the mark-release-recapture (MRR) experiment, strongly indicates that *P. megistus* exhibits a life-history strategy aligned with K-strategists. This concept, drawn from the r/K selection theory (Pianka 1970), contrasts species that prioritize competitive ability and persistence in stable environments (K-strategists) with those that prioritize rapid reproduction and high fecundity in variable environments (r-strategists). The traits observed in our study—including high daily survival rate, long developmental cycle, and population stability over time—collectively reinforce this classification. Within the Triatominae subfamily, this profile contrasts with species like *Triatoma sordida*, which exhibits faster development and more explosive population cycles, suggesting a closer alignment to an r-strategist profile. A more definitive characterization, however, would require systematic comparative studies under standardized conditions.

The demonstrated stability of the colony reinforces the significant capacity of *P. megistus* to adapt to and thrive in artificial ecotopes, as previously indicated by Forattini *et al.* (1977, 1979, 1984). This successful establishment in a peridomestic structure highlights the species' key role in maintaining the enzootic cycles of *Trypanosoma cruzi* and confirms its capacity for spontaneous domiciliation. Therefore, the central conclusion of this work is that *P. megistus*, beyond its recognized ecological plasticity, employs a K-strategist life-history strategy oriented toward long-term persistence in stable environments. This ecological profile has direct implications for vector surveillance and control, as such populations are likely to be resilient but also predictable in their dynamics. Given the heightened epidemiological relevance conferred by its high survival rate, our results underscore the critical importance of sustained entomological surveillance, particularly in regions with forest remnants. Integrating findings on genetics, biology, and distribution of the species, such as those by Villela *et al.* (2000), will be essential for a comprehensive understanding of its ecology and behavior.

Conclusions

The findings demonstrate that *Panstrongylus megistus* exhibits traits consistent with a K-strategist species, including an extended developmental cycle, high survival rates, and long-term colony stability in artificial ecotopes. These characteristics distinguish it

from more opportunistic triatomines with shorter cycles and rapid population growth. The ability of *P. megistus* to establish and persist in artificial habitats underscores its epidemiological significance in maintaining *Trypanosoma cruzi* transmission cycles and highlights the need for sustained entomological surveillance, particularly in areas where sylvatic and peridomestic environments overlap.

Acknowledgments

The authors would like to thank biologists Marcos Takashi Obara and Paulo Roberto Urbinatti, insectary technicians João Luis Molina Gil and João Maurício Nóbrega Filho, as well as Mr. Olívio Lobatto, for their valuable assistance throughout the various stages of this research. We thank João Luis Molina Gil for providing the photo of the experimental chicken coop.

Author Contributions

CJW, JSMB, MTM: Conceptualization. **GZL, JAR, JKSS, JO:** Methodology. **CJW, JSMB, MTM, GZL:** Writing – original draft. **CJW, GZL, JAR, JKSS, JSMB, MTM, JO:** Writing – review & editing.

Financial Support

We appreciate the Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP), Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) - Finance Code 001, Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq)

Literature Cited

- Boyce, M.S. (1984)** Restitution of r- and K-selection as a model of density-dependent natural selection. *Annual Review of Ecology and Systematics*, 15: 427-447. <https://doi.org/10.1146/annurev.es.15.110184.002235>
- Chagas, C. (1909)** Nova tripanozomíase humana. Estudo sobre a morfologia e o ciclo evolutivo do *Schizotripanum cruzi* n. gen. sp, agente etiológico de nova entidade mórbida do homem. *Memórias do Instituto Oswaldo Cruz*, 1: 159-218.
- Damborsky, M.P., Bar, M.E. and Oscherov, E.B. (2001)** Detection of triatomines (Hemiptera: Reduviidae) in domiciliary and extra-domiciliary ecotopes, Corrientes, Argentina. *Cadernos de Saúde Pública*, 17: 843-849.
- Favoretto, S.R., de Mattos, C.C., de Mattos, C.A., Campos, A.C.A., Sacramento, D.R.V. and Durigon, E.L. (2013)** The emergence of wildlife species as a source of human rabies infection in Brazil. *Epidemiology and Infection*, 141(7): 1552-1561. <https://doi.org/10.1017/S0950268813000198>
- Forattini, O.P. (1980)** Biogeografia, origem e distribuição da domiciliação de triatomíneos no Brasil. *Revista de Saúde Pública*, 14: 265-299.
- Forattini, O.P., Ferreira, A.O., Rocha e Silva, E.O. and Rabello, E. (1977)** Aspectos ecológicos da tripanossomíase americana VIII – Domiciliação de *Panstrongylus megistus* e sua presença extradomiciliar. *Revista de Saúde Pública*, 11: 73-86.
- Forattini, O.P., Ferreira, A.O., Rabello, E.X., Barata, J.M.S. and Santos, J.L.F. (1984)** Aspectos ecológicos da tripanossomíase americana XX – Desenvolvimento e ciclos anuais de colônias de *Panstrongylus megistus* em ecótopos artificiais, no ambiente peri e extradomiciliar. *Revista de Saúde Pública*, 18: 30-40.

- Forattini, O.P., Ferreira, A.O., Rocha e Silva, E.O. and Rabello, E.X. (1973) Aspectos ecológicos da tripanossomose americana V – Observações sobre a colonização espontânea de triatomíneos silvestres em ecótopos artificiais, com especial referência ao *Triatoma sordida*. *Revista de Saúde Pública*, 7: 219-239.
- Forattini, O.P., Ferreira, A.O., Rocha e Silva, E.O. and Rabello, E.X. (1978) Aspectos ecológicos da tripanossomíase americana XII – Variação regional da tendência de *Panstrongylus megistus* à domiciliação. *Revista de Saúde Pública*, 12: 209-233.
- Forattini, O.P., Rocha e Silva, E.O., Ferreira, A.O. and Rabello, E.X. (1979) Aspectos ecológicos da tripanossomíase americana XV – Desenvolvimento, variação e permanência de *Triatoma sordida*, *Panstrongylus megistus* e *Rhodnius neglectus* em ecótopos artificiais. *Revista de Saúde Pública*, 13: 220-234.
- Galvão, C., Gil-Santana, H.R. and Oliveira, J. (2024) The taxonomic catalog of the Brazilian fauna: biodiversity and geographical distribution of Triatominae (Hemiptera: Reduviidae) in Brazil. *Zoologia (Curitiba)*, 41: e24006.
- Guilherme, A.L., Pavanelli, G.C., Silva, S.V., Costa, A.L. and Araujo, S.M. (2001) Secondary triatomine species in dwellings and other nearby structures in municipalities under epidemiological surveillance in the state of Paraná, Brazil. *Revista Panamericana de Salud Pública*, 9: 385-392.
- Heitzmann-Fontenelle, T.J. (1976) Bionomia comparativa de triatomíneos. I – *Panstrongylus megistus* (Burm., 1835) (Hemiptera, Reduviidae). *Studia Entomologica*, 19: 1-4.
- Heitzmann-Fontenelle, T.J. (1980/1981) Bionomia dos triatomíneos – o surgimento de adultos nas colônias de *Panstrongylus megistus* (Burmeister, 1835) (Hemiptera, Reduviidae). *Memórias do Instituto Butantan*, 44/45: 343-353.
- Lent, H. and Wygodzinsky, P. (1979) Revision of the Triatominae (Hemiptera, Reduviidae), and their significance as vectors of Chagas' disease. *Bulletin of the American Museum of Natural History*, 163: 123-520.
- Mello, F., Souza, G.D., Bedin, C., Duarte, M.B., Leon, Í.F. and Villela, M.M. (2023) Occurrence and distribution of *Panstrongylus megistus* (Burmeister, 1835) (Hemiptera, Reduviidae) in a metropolitan area of Southern Brazil. *Revista do Instituto de Medicina Tropical de São Paulo*, 65: e35. <https://doi.org/10.1590/S1678-9946202365035>
- Monroy, M.C., Bustamante, D.M., Rodas, A.G., Enriquez, M.E. and Rosales, R.G. (2003) Habitats, dispersion and invasion of sylvatic *Triatoma dimidiata* (Hemiptera: Reduviidae: Triatominae) in Petén, Guatemala. *Journal of Medical Entomology*, 40: 800-806.
- Nascimento, C., Marassa, A.M., Curado, I. and Piazza, R.M. (1997) The finding of *Panstrongylus megistus* in an artificial ecotope: taking up residence or merely visiting? *Revista da Sociedade Brasileira de Medicina Tropical*, 30: 333-336.
- Patterson, J.S., Barbosa, S.E. and Feliciangeli, M.D. (2009) On the genus *Panstrongylus* Berg 1879: Evolution, ecology and epidemiological significance. *Acta Tropica*, 110: 187-199. <https://doi.org/10.1016/j.actatropica.2008.09.008>
- Pianka, E.R. (1970) On R- and K-selection. *The American Naturalist*, 104: 592-597.
- Pires, H.H.R., Lazzari, C.R., Schilman, P.E., Diotaiuti, L. and Lorenzo, M.G. (2002) Dynamics of thermopreference in the Chagas disease vector *Panstrongylus megistus* (Hemiptera: Reduviidae). *Journal of Medical Entomology*, 39: 716-719.
- Ribeiro Castro, M.A.L., de Souza Castro, G.V., de Souza, J.L., de Souza, C.R., Ramos, L.J., de Oliveira, J., da Rosa, J.A., Aranha Camargo, L.M. and Meneguetti, D.U.O. (2018) First report of *Panstrongylus megistus* (Hemiptera, Reduviidae, Triatominae) in the State of Acre and Rondônia, Amazon, Brazil. *Acta Tropica*, 182: 158-160. <https://doi.org/10.1016/j.actatropica.2018.02.032>
- Santos Jr., J.E., Viola, M.G., Lorosa, E.S., Machado, E.M.M., Ruas Neto, A.L. and Corseuil, E. (2013) Evaluation of natural foci of *Panstrongylus megistus* in a forest fragment in Porto Alegre, State of Rio Grande do Sul, Brazil. *Revista da Sociedade Brasileira de Medicina Tropical*, 46(5): 575-583. <https://doi.org/10.1590/0037-8682-0149-2013>

- Silveira, A. and Vinhaes, M. (1999)** Elimination of vector-borne transmission of Chagas disease. *Memórias do Instituto Oswaldo Cruz*, 94: 405-411.
- Steindel, M., Toma, H.K., Pinto, C.J.C., Grisard, E.C. and Schlemper Jr., B.R. (1994)** Colonization of artificial ecotopes by *Panstrongylus megistus* in Santa Catarina Island, Florianópolis, Santa Catarina, Brazil. *Revista do Instituto de Medicina Tropical de São Paulo*, 36: 43-50.
- Travis, J., Bassar, R.D., Coulson, T., Reznick, D. and Walsh, M.R. (2023)** Density-dependent selection. *Annual Review of Ecology, Evolution, and Systematics*, 54: 85-105. <https://doi.org/10.1146/annurev-ecolsys-110321-055345>
- Villela, M.M., Souza, J.B., Mello, V.P., Azeredo, B.V. and Dias, J.C. (2005)** Entomological surveillance for Chagas disease in the mid-western region of Minas Gerais State, Brazil, from 2000 to 2003. *Cadernos de Saúde Pública*, 21: 878-886.