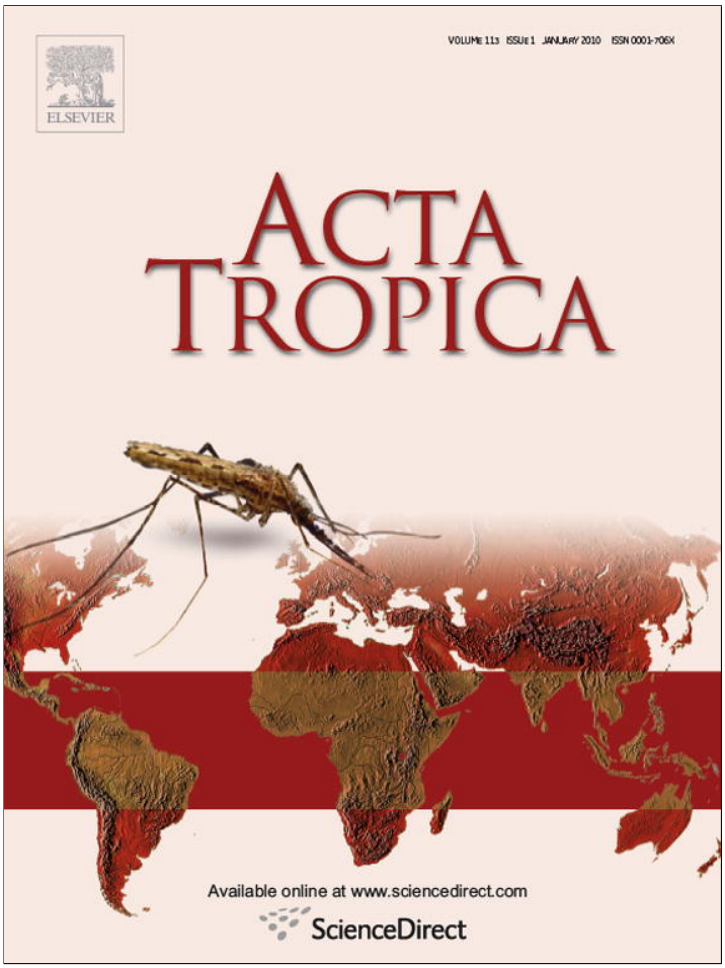

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Short communication

Lutzomyia migonei as putative vector of visceral leishmaniasis in La Banda, Argentina

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ABSTRACT

Four autochthonous cases of human visceral leishmaniasis (VL) were reported in La Banda, Santiago del Estero from June 2007 to May 2008. In the vicinity of these cases there were 3/47 rK39 sero-positive dogs, and another 4 dogs with VL were reported by passive surveillance. The sero-positive dogs and infected humans lived within a 3.1 km radius. Phebotomine sand fly captures were performed twice during November/December 2007 and April 2008. In 20 of the 59 sampled sites in the areas of the human and canine cases (220 night/traps) 151 phlebotomine sand flies were collected and consisted of: *Lutzomyia migonei* 93%, *Lutzomyia cortelezzii* 5.6% and *Lutzomyia neivai* 1.4%. We propose that there was an enzootic cycle of VL with accidental human transmission due to *L. migonei* and suggest that there be a surveillance of human isolated cases of VL within the *L. migonei* dispersion area.

Transmission of *Leishmania* (*L.*) *infantum* (syn. *Leishmania chagasi*) was reported in Argentina from 1922 to 1989 as scattered human cases, in areas without records of *Lutzomyia longipalpis*, its usual vector in America (Salomón et al., 2001). During the last decades, however, urban outbreaks of visceral leishmaniasis (VL) have spread to the south of South America reaching Mato Grosso do Sul in Brazil, and Asunción in Paraguay, close to the Argentinian northern border (Panaftosa, 2006; Correa Antonialli et al., 2007; Mestre and Fontes, 2007). In December 2004 *L. longipalpis* was found in Clorinda, Argentina, 40 km from Asunción (Salomón and Orellano, 2005), and in 2006 the first autochthonous urban focus of VL associated with *L. longipalpis* was reported in Posadas, Argentina (Salomón et al., 2008a).

In June 2007 a 6-year-old boy from La Banda, province of Santiago del Estero, was diagnosed with VL clinically and parasitologically (Riarte AR, Altcheh JM comm. pers.), and the parasite was genotyped as *L. infantum* (Pravia CA, Cupolillo E comm. pers.). The child had not moved from his house located in the 'Chaco' central dry bioregion of Argentina, 700 km from Clorinda and 830 km from Posadas, both in the subtropical humid area. Up until May, 2008 this case was followed by three other human VL cases in children also from La Banda. Therefore, for each case an entomological screening and an active search of canine VL was performed.

La Banda city (27°44′LS 64°14′LW, 10–200 masl), is located in the center-west of the province of Santiago del Estero. It has 95,000 inhabitants living in an area of 42 km^2 that belongs to the 'Chaco' bioregion. The city was built on the eastern bank of the Dulce river alluvial plain. The climate is subtropical continental with dry season (April–September), mean annual temperature 21, 5 °C (−5 °C to 47 °C), and 520 mm of annual average rainfall (Salomón et al., 2008b).

Phlebotominae sand flies were caught with minilight CDC traps operating overnight from 19:00 to 9:00 h. The traps were located in the yard of the house of each human case (three former cases), all the houses in the block where the infected child lives, and at least one house in each neighboring block up to 450 m from the case. At each site the trap operated for two consecutive nights, simultaneously at all the sites around each case. Fifty-three sites were sampled from 11/27 to 12/6, 2007, and again from 4/9 to 4/11, 2008 (212 night/traps). In the last capture four sites with infected dogs were added (8 night/traps). The sand flies were kept dry until they were macerated and mounted in lacto-phenol to be identified following the key of Young and Duncan from 1994, with *Lutzomyia neivai* as described by Andrade Filho et al. in 2003.

In April 2008 all the dogs from those blocks in which cases had been detected were observed for clinical signs, and samples were taken to be tested with rK39 dipsticks (InBios, Seattle, WA). The owners were asked about symptoms of dead dogs during the last year. The Veterinary Society of Santiago del Estero/La Banda cities was asked for an active search of dogs with VL compatible symptoms, and the sera of the suspected dogs were also tested by rK39.

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Table 1
Phlebotomine sampled with CDC traps in La Banda, Santiago del Estero, Argentina, in 2007 (11/27–12/6), and 2008 (4/9–4/11) by site and species (only sites of the cases and neighbors with phlebotomine).

	Coordinates (LS, LW)	2007		2008	
		L. migonei	*L. cortelezzii*	*L. neivai*	*L. migonei*
C1	27°44′41.9″, 64°14′54.1″	–	–	–	–
N1	27°44′47.2″, 64°14′48.9″	–	–	–	2
C2	27°45′00.8″, 64°14′58.5″	–	–	–	–
N2	27°45′00.9″, 64°14′58.2″	1	–	–	–
N2	27°45′00.7″, 64°14′59.4″	3	–	–	6
N2 + D[a]	27°45′01.3″, 64°14′59.3″	3	–	–	–
N2	27°45′01.0″, 64°14′59.1″	3	–	1	9
N2	27°44′59.9″, 64°14′58.1″	1	–	–	–
C3 + D	27°43′59.4″, 64°15′36.2″	2	1	–	0
C3	27°43′59.0″, 64°15′36.4″	11	3	–	4
N3	27°44′60.0″, 64°15′36.7″	5	4	–	–
N3	27°44′00.6″, 64°15′36.5″	37	–	–	14
N3	27°43′59.9″, 64°15′36.5″	1	–	–	–
N3	27°44′01.1″, 64°15′35.9″	3	–	–	–
N3	27°43′58.5″, 64°15′34.5″	1	–	–	–
N3	27°43′58.7″, 64°15′32.8″	1	–	–	–
N3	27°44′02.5″, 64°15′40.0″	2	–	1	–
N3	27°43′56.8″, 64°15′33.6″	1	–	–	–
D	28°44′33.8″, 64°14′27.4″	–	–	–	1
D	28°44′30.0″, 64°14′29.5″	–	–	–	28
D	27°45′51.6″, 62°12′22.8″	–	–	–	2
D	27°45′44.0″, 64°12′39.8″	–	–	–	–

C: human case; N: neighbor of human case; D: infected dog (D[a] two infected dogs).

The files of the Health Centers of the province sent to the Secretary of Statistics (Ministry of Health, Santiago del Estero) from 01/01/2005 to 07/31/07 were checked. Suspected VL patients were included based on the following criteria—Individuals hospitalized with one or more of these symptoms: splenomegaly, hepatomegaly, adenomegaly, weight loss or persistent febrile syndrome without diagnosis or etiological agent confirmation different from *Leishmania*.

The former three human cases lived in a 1-km radius within the urban area far from the edges of the city (Table 1). A fourth case was diagnosed in May 2008, after the sand fly trapping, and lives 200 m from a previous case (LS 27°44′03.7″, LW 64°15′43.6″). The four cases were natives without antecedents of recent migrations.

The dog infection search found 7/51 rK39 positive dogs: 2/24 from case 2 surroundings, both owned by his closest neighbor, 1/23 from case 3 surroundings owned by case 3, 4/4 sent by the active search of private veterinarians. Five positive dogs were oligosymptomatic, and two symptomatic. Neither dead dogs nor other dogs with suspected VL were found. Dog and human cases lived within an area of 3.1 km radius (Table 1). All the rK39 positive dogs were natives without antecedents of recent migrations.

In 20 of the 59 sampled sites 151 phlebotomine sand flies were collected: *Lutzomyia migonei* 93%, *Lutzomyia cortelezzii* 5.6%, and *L. neivai* 1.4% (Table 1). Case 1: two *L. migonei* at 1/21 sites at 173 m from the domicile of the infected child, in a house with chickens and dogs on the edge of a sewer pond, where the child used to spend nights. Case 2: 27 phlebotomine (26 *L. migonei*) at 5/17 sites up to 15 m from the house of the infected child, in front of a water canal with pigs and garbage (Fig. 1A). Case 3: 91 phlebotomine (82 *L. migonei*) at 10/15 sites up to 141 m from the home of the infected child, although 80% of these sand flies were obtained in a 14-m radius area around the human + dog case, in front of an open refuse dump with horses, pigs and dogs (Fig. 1B). Dogs with VL (passive surveillance): *L. migonei* at three of the four sites, sampled after the infected dogs had been culled, in the place where a new dog sleeps.

The retrospective study of 125,215 hospital records from 2005 to 2007 found 61 cases with at least one symptom of VL, 51 had a no-VL confirmed diagnosis, and the remaining 10 could not be included or excluded due to a record number of inconsistencies or missing files.

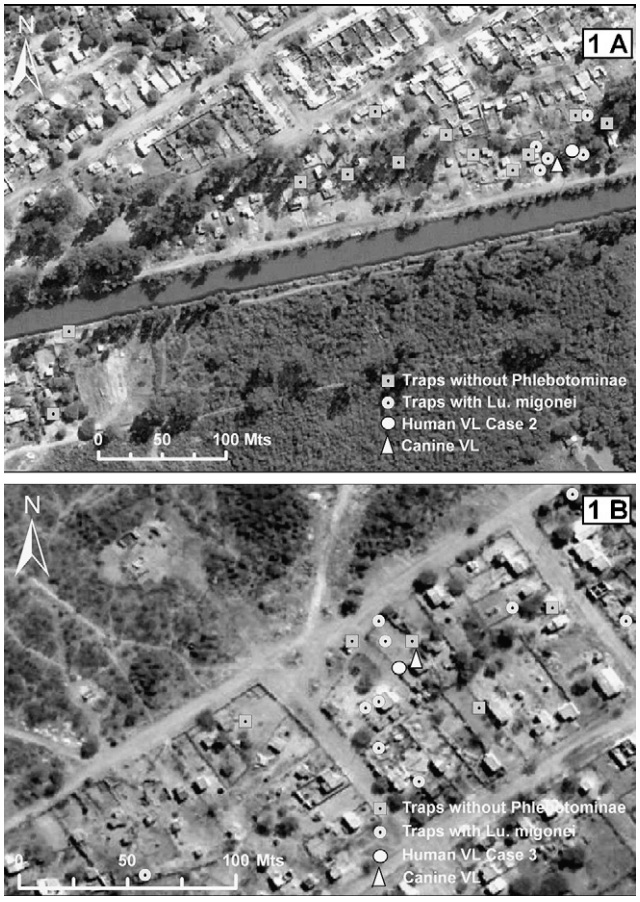

Fig. 1. Phlebotomine trap sites, *Lutzomyia migonei* presence, and canine visceral leishmaniasis cases around human visceral leishmaniasis case 2 (A) and case 3 (B), La Banda, Santiago del Estero, Argentina. The image was taken from Google Earth, version 4.0.2416 (beta) http://earth.google.es.

Four children and seven dogs were infected by *L. infantum* clustering in time and space in La Banda, within the 'Chaco' dry region of Argentina. The human cases were treated satisfactorily with antimonials, the positive dogs were culled, and the houses up to 150 m from each case were sprayed with cypermethrin 25%. No more canine or human VL cases were reported until now. The ratio between human VL: canine VL was 1 taking into account the dogs around the human cases while in other foci of America it could range from 80 to 290 (Margonari et al., 2006; Mestre and Fontes, 2007). *L. longipalpis* was not found but *L. migonei* was the prevalent species around the cases, in peridomestic environments in which there were plenty of domestic animals. The trapping was performed during late spring and early autumn, before and after the rainy season, the two peaks of sand fly activity known for other phlebotomine species in Argentina (Salomon et al., 2004), and for *L. longipalpis* in foci of Brazil (Oliveira et al., 2008; Michalsky et al., 2009). Although the presence of *L. longipalpis* could not be eliminated, four canine cases were diagnosed immediately after the first sampling, and the fourth human case immediately after the second sampling, while none *L. longipalpis* was captured during was captured during this study related to the cases or previous studies in the area (Salomón et al., 2008b).

Species different from *L. longipalpis* were already incriminated as vectors of *L. infantum*, *Lutzomyia cruzi* (Santos et al., 1998; Missawa and Lima, 2006), *L. pseudolongipalpis* (Feliciangeli et al., 2006), and *Lutzomyia evansi* (Travi et al., 1990; Feliciangeli et al., 1999). Natural infections by *L. infantum* detected by PCR were reported in *Lutzomyia forattinii* (de Pita-Pereira et al., 2008) and *L. cortelezzii* (Carvalho et al., 2008). *Lutzomyia shannoni* and *Lutzomyia youngi* could be putative vectors (Travi et al., 2002), while *Lutzomyia intermedia*, *Lutzomyia whitmani*, *Lutzomyia antunesi*, *Lutzomyia furcata*, *Lutzomyia davisi* and *Lutzomyia flaviscutellata* were suggested as vectors due to their epidemiological association with VL foci where known vectors are absent (Lainson and Rangel, 2005). *L. migonei* was also proposed as a potential vector of *L. infantum* for a focus with scarce cases of VL (Souza et al., 2003).

Further, in Pernambuco, Brazil, in a municipality with six cases of VL and *L. infantumi* isolated from dogs, no *L. longipalpis* was found among 15,255 phlebotomine collected, while 89% of the sand flies from the houses, and 96% from the domestic animal dwellings were *L. migonei* (de Carvalho et al., 2007). *L. migonei* was also proposed as a vector linking cutaneous leishmaniasis with the enzootic and anthropozoonotic transmission (Chaves and Añez, 2004; Salomón et al., 2006). Therefore, *L. migonei* adaptation to manmade modified environments, and its relative anthropophilic behavior as well as its avidity for equines, might contribute to the sporadic pattern of VL transmission in the 'Chaco' region where it is the prevalent species (Salomón et al., 2008b). However, this hypothesis requires further investigations of natural and experimental infections that would contribute to the incrimination of *L. migonei* as a specific or permissive vector *L. infantum* (Volf and Myskova, 2007).

In conclusion, *L. infantum* transmission in a focus within the dry 'Chaco' region showed a different pattern from that found in the only urban outbreak of visceral leishmaniasis reported up to now in Argentina (Salomón et al., 2008a): almost the same number of human and dog cases, without *L. longipalpis* but *L. migonei*. This putative vector species was associated with environment degradation, social vulnerability, periurban–rural transition habitats, and domestic animals. The scattered pattern of VL incidence in the central region of Argentina, without any proven vector (Salomón et al., 2001), also supports the hypothesis of an enzootic cycle with accidental human transmission. Taking into account the wide distribution of *L. migonei* in Argentina, Bolivia, Brazil, Paraguay, Peru, Colombia, Venezuela, and Trinidad and Tobago, and that the former four countries share the 'Chaco' region, a sporadic, underlying VL transmission could not be eliminated, and so the surveillance for VL isolated human cases is suggested.

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References

Andrade Filho, J.D., Galati, E.A., Falcão, A.L., 2003. Redescription of *Nyssomyia intermedia* (Lutz & Neiva, 1912) and *Nyssomyia neivai* (Pinto, 1926) (Diptera: Psychodidae). Mem. Inst. Oswaldo Cruz 98, 1059–1065.

Carvalho, G.M., Andrade Filho, J.D., Falcão, A.L., Rocha Lima, A.C., Gontijo, C.M., 2008. Naturally infected *Lutzomyia* sand flies in a *Leishmania*-endemic area of Brazil. Vector Borne Zoonotic Dis. 8, 407–414.

Chaves, L.F., Añez, N., 2004. Species co-occurrence and feeding behavior in sand fly transmission of American cutaneous leishmaniasis in western Venezuela. Acta Trop. 92, 219–224.

Correa Antonialli, S.A., Torres, T.G., Paranhos Filho, A.C., Tolezano, J.E., 2007. Spatial analysis of American visceral leishmaniasis in Mato Grosso do Sul State, Central Brazil. J. Infect. 54, 509–514.

de Carvalho, M.R., Lima, B.S., Marinho-Júnior, J.F., da Silva, F.J., Valença, H.F., Almeida, F.A., da Silva, A.L., Brandão-Filho, S.P., 2007. Phlebotomine sandfly species from an American visceral leishmaniasis area in the Northern Rainforest region of Pernambuco State, Brazil. Cad. Saúde Pública 23, 1227–1232.

de Pita-Pereira, D., Cardoso, M.A.B., Alves, C.R., Brazil, R.P., Britto, C., 2008. Detection of natural infection in *Lutzomyia cruzi* and *Lutzomyia forattinii* (Diptera: Psychodidae: Phlebotominae) by *Leishmania infantum* in an endemic area of visceral leishmaniasis in Brazil using a PCR multiplex assay. Acta Trop. 107, 66–69.

Feliciangeli, M.D., Rodriguez, N., De Guglielmo, Z., Rodriguez, A., 1999. The re-emergence of American visceral leishmaniasis in an old focus in Venezuela. II. Vectors and parasites. Parasite 6, 113–120.

Feliciangeli, M.D., Delgado, O., Suarez, B., Bravo, A., 2006. *Leishmania* and sand flies: proximity to woodland as a risk factor for infection in a rural focus of visceral leishmaniasis in west central Venezuela. Trop. Med. Int. Health 11, 1785–1791.

Lainson, R., Rangel, E.F., 2005. *Lutzomyia longipalpis* and the eco-epidemiology of American visceral leishmaniasis, with particular reference to Brazil: a review. Mem. Inst. Oswaldo Cruz 100, 811–827.

Margonari, C., Freitas, C.R., Ribeiro, R.C., Moura, A.C., Timbó, M., Gripp, A.H., Pessanha, J.E., Dias, E.S., 2006. Epidemiology of visceral leishmaniasis through spatial analysis, in Belo Horizonte municipality, state of Minas Gerais, Brazil. Mem. Inst. Oswaldo Cruz 101, 31–38.

Mestre, G.L., Fontes, C.J., 2007. A expansão da epidemia da leishmaniose visceral no Estado de Mato Grosso, 1998–2005. Rev. Soc. Bras. Med. Trop. 40, 42–48.

Missawa, N.A., Lima, G.B., 2006. Distribuição espacial de *Lutzomyia longipalpis* (Lutz & Neiva, 1912) e *Lutzomyia cruzi* (Mangabeira, 1938) no estado de Mato Grosso. Rev. Soc. Bras. Med. Trop. 39, 337–340.

Michalsky, E.M., França-Silva, J.C., Barata, R.A., Lara e Silva, F.de O., Loureiro, A.M., Fortes-Dias, C.L., Dias, E.S., 2009. Phlebotominae distribution in Janaúba, an area of transmission for visceral leishmaniasis in Brazil. Mem. Inst. Oswaldo Cruz 104, 56–61.

Oliveira, A.G., Galati, E.A., Fernandes, C.E., Dorval, M.E., Brazil, R.P., 2008. Seasonal variation of *Lutzomyia longipalpis* (Lutz & Neiva, 1912) (Diptera: Psychodidae: Phlebotominae) in endemic area of visceral leishmaniasis, Campo Grande, state of Mato Grosso do Sul, Brazil. Acta Trop. 105, 55–61.

Panaftosa, 2006. Informe final de la reunión de expertos OPS/OMS sobre Leishmaniasis Visceral en las Américas. Panaftosa, Rio de Janeiro, Brazil, pp. 1–152.

Salomón, O.D., Rossi, G., Sosa Estani, S., Spinelli, G., 2001. Presencia de *Lutzomyia longipalpis* y situación de la leishmaniosis visceral en Argentina. Medicina (Buenos Aires) 61, 174–178.

Salomon, O.D., Wilson, M.L., Munstermann, L.E., Travi, B.L., 2004. Spatial and temporal patterns of Phlebotominae sand flies (Diptera: Psychodidae) in a cutaneous leishmaniaisis focus in Northern Argentina. J. Med. Entomol. 41, 33–39.

Salomón, O.D., Orellano, P.W., 2005. *Lutzomyia longipalpis* in Clorinda, Formosa province, an area of potential visceral leishmaniasis transmission in Argentina. Mem. Inst. Oswaldo Cruz 100, 475–476.

Salomón, O.D., Orellano, P.W., Quintana, M.G., Pérez, S., Sosa Estani, S., Acardi, S., Lamfri, M., 2006. Transmisión de la leishmaniasis tegumentaria en Argentina. Medicina (Buenos Aires) 66, 211–219.

Salomón, O.D., Sinagra, A., Nevot, M.C., Barberian, G., Paulin, P., Estévez, J.O., Riarte, A., Estévez, J., 2008a. First visceral leishmaniasis focus in Argentina. Mem. Inst. Oswaldo Cruz 103, 109–111.

Salomón, O.D., Rosa, J.R., Stein, M., Quintana, M.G., Fernández, M.S., Visintín, A., Spinelli, G.R., Bogado de Pascual, M., Molinari, M.L., Morán, L., Valdez, D., Bruno, M.R., 2008b. Phlebotominae fauna in the Chaco region and cutaneous leishmaniasis transmission patterns in Argentina. Mem. Inst. Oswaldo Cruz 103, 578–584.

Santos, S.O., Arias, J., Ribeiro, A.A., Hoffmman, M.P., Freitas, R.A., Malacco, M.A.F., 1998. Incrimination of *Lutzomyia cruzi* as a vector of American Visceral Leishmaniasis. Med. Vet. Entomol. 12, 315–317.

Souza, M.B., Marzochi, M.C.A., Carvalho, R.W., Ribeiro, P.C., Pontes, C.S., Caetano, J.M., Meira, A.M., 2003. Ausência da *Lutzomyia longipalpis* em algumas áreas de ocorrência de leishmaniose visceral no Municipio do Rio de Janeiro. Cad. Saúde Pública 19, 1881–1885.

Travi, B.L., Vélez, I.D., Brutus, L., Segura, I., Jaramillo, C., Montoya, J., 1990. *Lutzomyia evansi* an alternate vector of *Leishmania chagasi* in a Colombian focus of visceral leishmaniasis. Trans. R. Soc. Trop. Med. Hyg. 84, 676–677.

Travi, B.L., Ferro, C., Cadena, H., Montoya-Lerma, J., Adler, G.H., 2002. Canine visceral leishmaniasis: dog infectivity to sand flies from non-endemic areas. Res. Vet. Sci. 72, 83–86.

Volf, P., Myskova, J., 2007. Sand flies and *Leishmania*: specific versus permissive vectors. Trends Parasitol. 23, 91–92.

Young, D.G., Duncan, M.A., 1994. Guide to the identification and geographic distribution of *Lutzomyia* sand flies in Mexico, the West Indies, Central and South America (Diptera: Psychodidae). Mem. Am. Entomol. Instit. 54, 1–881.