Alien spiders in Chile: evaluating Darwin’s naturalization hypothesis

Andrés Taucare-Ríos and Ramiro O. Bustamante: Departamento de Ciencias Ecológicas, Instituto de Ecología y Biodiversidad, Facultad de Ciencias Universidad de Chile, Las Palmeras 3425, Santiago, Chile. E-mail: and.taucare26@gmail.com

Abstract. Darwin’s naturalization hypothesis (DNH) states that the successful establishment of alien species is favored when the phylogenetic relationship between the colonizer and the recipient community is distant. From a population perspective, the establishment involves both the progressive increase in size and spatial distribution of the invasive population. In this study, we focused our attention on the spatial component of establishment, assessing the role of phylogenetic relatedness as a determinant of its extension. Following DNH, it is expected that alien species closely related to the native spiders would show narrower distribution ranges than alien taxa less related to the native species. We found 18 alien spider species in Chile; all of these are synanthropic and most are of African origin. Our results indicate a difference in range size between related and unrelated species but it was not statistically significant. Consequently, the results do not support DNH as an explanation of the distributional component of establishment of alien spider species in Chile. We conclude that ecological constraints do not affect the process of invasion of spiders; therefore, it is only time that determines the spread of alien spiders in this country.

Keywords: Aerial dispersal, biological invasion, geographic range, residence time, phylogenetic relatedness

Establishment of species beyond their natural range is on the rise because of increasing trade, transport, travel and tourism that are part of globalization. This provides living plants, animals and biological materials with vectors and pathways crossing the biogeographical barriers that would usually block their way (Shine et al. 2009).

Currently, organisms belonging to different taxonomic groups are translocated from one region to another, with which they do not share a prior history (Williamson 1996; Davis 2009). Although it is estimated that most of the organisms that disperse do not successfully establish in the target area, sometimes a small number of propagules can configure a founder colony and become established (Kolar & Lodge 2001; Sakai et al. 2001). One of the central challenges in the study of biological invasions has been to understand what factors determine this establishment process (Williamson 1996; Lockwood et al. 2007; Davis 2009), understood as a population expansion event.

Several hypotheses have been proposed to explain why some species are able to establish and others are not (Kolar & Lodge 2001; Mitchell et al. 2006). A particularly intriguing theory has been called Darwin’s naturalization hypothesis (DNH) (Daehler 2001). This hypothesis, originally proposed by Darwin (1859), assumes that establishment success is influenced by the phylogenetic relationship between the colonizer and the members of the receiving community (Chesson 2000; Adler et al. 2007). In this context, invasive species that exhibit close phylogenetic relationships with the recipient community should display a high niche overlap, thus generating a high intensity of competition with members of the receiving community (Cavender-Bares et al. 2009; Mayfield & Levine 2010). Therefore, under conditions of greater phylogenetic relationship to the recipient community, a colonizer would less likely establish oneself. Inversely, when the colonizer has a low level of relationship with members of the community, DNH suggests that competitive intensity decreases, a fact that will help to facilitate the establishment of invasive species. Although there are various concepts of establishment (Richardson et al. 2000), from the population point of view, establishment can be visualized as a process in which a colony of alien species, once introduced, independent of intentional human assistance, has its population increase in size and expands into an area of colonization (Shigesada & Kawasaki 2001). Thus, depending on the abundance and distribution levels, it is possible to recognize various stages of progress in the establishment process (Shigesada & Kawasaki 2001). Therefore, if the phylogenetic relationship determines the distribution component, as predicted by DNH, alien species more related to members of the community would show smaller distributional ranges when compared to those of less related taxa.

Generalist arthropod predators include invasive species that are capable of affecting native species through a variety of direct and indirect pathways (Snyder & Evans 2006). Invasive generalist arthropod predators can displace native predators primarily through competition, intraguild predation, transmission of disease, and escape from predation and/or parasites (Snyder et al. 2004). As generalist arthropod predators, spiders have the potential to affect native arthropod species assemblages; nevertheless, spiders have been largely overlooked as invasive species (but see Nyffeler et al. 1986; Hann 1990; Gruner 2005). Once established, invasive spiders may be viewed as either beneficial arthropods in agroecosystems, or as keystone predators in native ecosystems. Documented displacements of native spiders by invasive spider species are rare, although Nyffeler et al. (1986) and Hann (1990) reported cases of competitive exclusion between invasive and native spider species in Europe and New Zealand, respectively.

Because distributional range is one of the components of the establishment process, the objective of this study is to evaluate DNH and its effect on the distributional range of alien spiders in continental Chile. For this, we characterized the distributional ranges of alien spiders that differ in phylogenetic relatedness to native spiders, while also considering other
possible factors that can affect range size such as the minimum residence time (i.e., the time since the introduction of a species to a region) and aerial dispersal or ballooning (Thebaud & Simberloff 2001; Bell et al. 2005).

METHODS

Spider data and distributional range.—We used the World Spider Catalog (2014) for assigning the distribution of species in the world; also we complemented these data with an intensive literature survey and collections in different cities of Chile to determine the distribution in the national territory. We considered alien species that are not native to the country and/or have a cosmopolitan distribution in the world today, where the current distribution already reflects human influence. Single records of non-established spider species and doubtful records were excluded. From this information, the total number of administrative regions occupied by each species was established and then the latitudinal extension (in kilometers) was determined. For this purpose, the distributional range was estimated as the sum of the maximum length of each occupied administrative region (Instituto Geografico Militar 2010); this procedure assumes that each species is distributed throughout each region (see Castro et al. 2005).

The phylogenetic relatedness between the alien spiders and resident community was classified in three levels. The first level (Close group) was used for species belonging to a genus that is represented in the native fauna of Chile. The second level (Intermediate group) was used for species belonging to genera not represented in the native spider fauna but from a family present in the native fauna. Finally, the third and most distant level (Distant group) was used for species belonging to genera and families not represented in the native spiders.

Because the area of origin is quite often not well known, the most probable origin of these spiders was taken from Kobelt & Nentwig (2008). The alien spider origins were attributed to the following five categories: a) Africa, b) Asia, c) Europe, d) America (refers to the tropical part of America) and e) “unknown” when the origin of some alien spider species is not exactly known but the species is globally distributed.

The minimum residence time was obtained from the oldest known record of the species obtained from historical information and collections. In addition, a measure of aerial dispersal, or ballooning, was included at an ordinal scale of 0 = not known, 1 = present, based on Bell et al. (2005).

Statistical analyses.—We performed a Generalized Linear Model (GLM) with normal error structure and the identity link function using STATISTICA 6.0 program (Stat Soft 1999) for analyzing simultaneously the effect of categorical (dispersal mode, phylogenetic relatedness) and continuous (residence time) variables on the dependent variable (distribution range, in km). The normality of residuals was analyzed with a Kolmogorov-Smirnov test after fitting the model. Phylogenetic relatedness was used to test DNH where dispersal mode and residence time were tested for other ecological factors that can explain distribution range.

RESULTS

Taxonomy of alien species and distribution in Chile.—We found 18 alien species belonging to 11 families. All alien spiders in this study are synanthropic species with 13 being considered cosmopolitan (Table 1), where Theridiidae were represented by four species, the most abundant family. The families Araneidae, Agelenidae, Pholcidae, and Salticidae were represented by two species each. Six other families are represented by only one species. The most astonishing aspect of the composition of the alien spider fauna is that it does not reflect the structure of the Chilean spider fauna. Only eight of the 11 families of alien spiders are also present in Chile. The families Agelenidae, Oecobiidae and Dysderidae are not represented in the native fauna (Fig. 1). Many of the spiders are of African origin (33.3%), followed by European (27.7%) and Asian species (22.2%) and finally South American species (5.5%); however, the biogeographical origin of the other species is unknown. The species of European origin are those with the highest average distributional range in Chile (2081 km), followed by the species of Asian origin (1738 km) (Table 2).

The regions with the highest number of alien species are the Tarapaca region (11 species) and the Antofagasta region (10 species) in northern Chile (Fig. 2). The spiders Pholcus phalangioides (Fuesslin 1775) (Pholcidae) and Steatoda grossa (C. L. Koch 1838) (Theridiidae) are the most widely distributed in Chile, being found from Arica (18° 28' S, 70° 52° W) to Magallanes (53° 9' S, 70° 55° W). Other species widely distributed in Chile are Dysdera crocata C. L. Koch 1838 (Dysderidae), Tegenaria domestica (Clerck 1757) (Agelenidae), Menemerus semilimbatus (Hahn 1827) (Salticidae), Urozelotes rusticus (L. Koch 1872) (Gnaphosidae) and Oecobius navus Blackwall 1859 (Oecobiidae). The species Hasarius adansonii (Audouin 1826) (Salticidae), Latrodectus geometricus C. L. Koch 1841 (Theridiidae), Heteropoda venatoria (Linnaeus 1767) (Sparassidae) and Smeringopus pallidus (Blackwall 1858) (Pholcidae) are found exclusively in the north of Chile (Table 1).

Minimum residence time.—Only three species had a minimum residence time greater than 100 years. Most species have a residence time between 1 and 24 years (Table 2). GLM analysis showed a significant positive effect of the minimum residence time on the size of the distributional range (Fig. 3) (GLM, F1, 11 = 37.7, P < 0.05). Spiders with longer residence time in the country include P. phalangioides, T. domestica, S. grossa, D. crocata and U. rusticus (Table 1).

Darwin’s naturalization hypothesis and distributional range.— Twenty eight per cent of alien species belong to a phylogenetically related group. Exactly half of the species belong to families already represented in the native fauna (Intermediate group); while the distant group represented only 22% of the alien species. The set of species with higher levels of phylogenetic relationship (Close group) with native fauna (i.e., congeneric species) had an averaged distribution range of 1452.2 km, while those distant species (Distant group) showed the greatest geographical extension (1710 km), but these differences were not statistically significant (GLM, F2,11 = 0.4, P = 0.65). The aerial dispersal did not affect the distribution range (GLM, F1, 11 = 0.9, P = 0.35).

DISCUSSION

We can say that the effect of residence time can be interpreted as a neutral hypothesis; only time of arrival of alien spiders is enough to predict invasiveness. If this is true,
then the effect of other ecological variables is not significant. We failed to prove that the aerial dispersal and the interspecific competition between phylogenetically related species (DNH) would play a significant role in the invasion success of the alien spiders in Chile. The distributional range increased in size as residence time in the invaded region increased.

The number of alien species represents about 2% of known spiders in Chile. The family Theridiidae includes the largest number of alien species, agreeing with the results obtained by Kobelt & Nentwig (2008). Apparently the species of this family have a predisposition to be alien due to their link with human dwellings (Kobelt & Nentwig 2008). Globally common families, such as Tetragnathidae, Lycosidae and Zodariidae, are not represented at all among the alien species in Chile, probably because some families are usually not associated with human infrastructure and have a rather low probability of becoming transported to foreign areas (Kobelt & Nentwig

| Taxa | Area of Origin | Geographic distribution | First record in Chile | Distribution in Chile |
|------|----------------|-------------------------|-----------------------|-----------------------|
| Araneidae | | | | |
| Argiope trifasciata | Africa | Cosmopolitan | Levi (1968) | From Salamanca to Lanquihue |
| Zygiella x-notata | Unknown | Cosmopolitan | Mello-Leitão (1951) | Very common in southern Chile, Santiago to Los Lagos Region |
| Ageleinae | | | | |
| Tegenaria domestica | Europe | Cosmopolitan | Simon (1904) | Center of Chile to Magallanes region |
| Tegenaria pagana | Europe | Europe to Central Asia, USA to Chile, New Zealand | Roth (1968) | Center of Chile: Metropolitan and Valparaiso region |
| Dysderidae | | | | |
| Dysdera crocata | Europe | Cosmopolitan | Nicolet (1849) | From Antofagasta to Bio-Bio Region |
| Oecobidae | | | | |
| Oecobius navus | Africa | Cosmopolitan | Santos & Gonzaga (2003) | North and center of Chile: From Iquique to Bio-Bio Region |
| Pholcidae | | | | |
| Pholcus phalangioides | Asia | Cosmopolitan | Nicolet (1849) | From Arica to Magallanes Region |
| Smeringopus pallidus | Africa | Pantropical | Taucare-Rios (2012) | North of Chile: Tarapaca Region |
| Prodidomidae | | | | |
| Prodidomus rufus | Unknown | Cosmopolitan | Platnick & Baehr (2006) | Antofagasta Region |
| Gnaphosidae | | | | |
| Urozelotes rusticus | Asia | Cosmopolitan | Simon (1904) | Atacama to Valparaiso Region |
| Salticidae | | | | |
| Hasarius adansonii | Africa | Cosmopolitan | Taucare-Rios (2013b) | Arica and Parinacota and Tarapaca Region |
| Menemerus semilimbatus | Africa | Canary Islands, southern Europe, western Asia, and Africa; and introduced to Argentina, Chile, and USA. | Taucare-Rios & Edwards (2012) | Arica and Parinacota to Maule Region |
| Scytodidae | | | | |
| Scytodes univittata | Asia | Canary Is. to Myanmar, synanthropic in Neotropics | Brescovit & Rheims (2000) | From Arica to Chañaral |
| Sparassidae | | | | |
| Heteropoda venatoria | Asia | Pantropical | Taucare-Rios & Brescovit (2011) | Tarapaca Region: Iquique |
| Theridiidae | | | | |
| Latrodectus geometricus | Africa | Cosmopolitan | Taucare-Rios (2011) | From Arica to Mejillones |
| Parasteatoda tepidariorum | South America | Cosmopolitan | Levi (1967) | North to center of Chile: Antofagasta to Santiago |
| Steatoda grossa | Europe | Cosmopolitan | Simon (1904) | From Arica to Magallanes |
| Steatoda triangulosa | Europe | Cosmopolitan | Taucare-Rios et al. 2013 | Tarapaca Region |
Most alien spiders are of African origin, which is consistent with the results obtained by Kobelt & Nentwig (2008), and currently have cosmopolitan distributions (Araneus trifasciatus (Forsskål 1775), H. adansoni, O. navus and L. geometricus) (Levi 1968; World Spider Catalog 2014). However, the species with the highest distributional range were the spiders of European origin, namely: D. crocata, S. grossa and T. domestica (Simon 1904; Roth 1968; Levi 1967; Ramirez et al. 2004; Taucare-Rios et al. 2013) (Table 2). A comparison between temperate and tropical origins indicates that about 30% of the species originate from temperate habitats (Europe) and about 60% are from the tropical habitats (Asia, Africa and America); the climate habitats of the others are unknown. Uncertainty, however, is high because for many species very little is known about the natural environment in which they live in the area of origin.

Residence time is a critical variable to predict invasiveness (Wilson et al. 2007), a fact that is reinforced by our results. The species with the highest residence time in Chile were P. phalangioides and D. crocata, described and reported for the first time in Chile over 160 years ago by Nicolet (1849). Similarly Urozelotes rusticus, Tegenaria domestica and Steatoda grossa, reported by Simon (1904), had a minimum residence time of about 110 years. To date, these species have significantly expanded their distribution in the country invading from the arid climate of northern Chile through the humid and cold climates in south Chile (Simon 1904; Cekalovic 1976; Platnick & Murphy 1984; Taucare-Rios 2010; Taucare-Rios et al. 2013). Other species reported in Chile have a wide distribution. These species include M. semilimbatus, Scytodes univitatta Simon 1882, Zygiella x-notata (Clerck 1757) and O. navus (Mello-Leitão 1951; Levi 1974; Brescovit & Rheims 2000; Santos & Gonzaga 2003;
Our results show that all alien spider species in the country are synanthropic and may not compete strongly with native species which do not usually inhabit urban environments, therefore, maybe competition is not relevant in the establishment of the alien spiders in Chile. Others factors could be more important for these animals in anthropogenic environments. For example, it is known that on a geographic level, macro-environmental conditions (climate, precipitation, temperature, etc.) do influence the size of a species’ range, even more than do interspecific interactions (see also Chesson 2000; Hubbell 2001; McKinney 2006; Sax et al. 2007).

This work summarizes knowledge about the alien spiders in Chile and the ecological process that may determine their establishment. In this context, our results do not support DNH, but do show the importance of minimum residence time for the establishment process of the alien spiders in Chile. Early warning plans will be very efficient to control the invasion of alien spiders, because in the absence of ecological constraints, the success of the invasion might be greater. However, future studies may shed light on other ecological processes involved in the successful invasion of these arthropods in Chile, mainly linked to the influence of human activity and possible events of facilitation in this country.

ACKNOWLEDGMENTS

Thanks to Leonardo Bacigalupe, Rick Vetter and Wolfgang Nentwig for critical comments on the manuscript. Thanks also to anonymous reviewers for their thorough evaluation and constructive recommendations for improving this manuscript. Finally, the first author thanks CONICYT grant No. 21130014 for National Doctoral studies. This project was partially funded by project ICM –PO5 – 002 to ROB.

LITERATURE CITED

Adler, P.B., J. Hille Ris Lambers & J.M. Levine. 2007. A niche for neutrality. Ecology Letters 10:95–104.

Bell, J.R., D.A. Bohan, E.M. Shaw & G.S. Weyman. 2005. Ballooning dispersal using silk: world fauna, phylogenies, genetics and models. Bulletin of Entomological Research 46:69–114.

Brandt, A.J., E.W. Seabloom & P.R. Hosseini. 2009. Phy logeny and provenance affect plant-soil feedbacks in invaded California grasslands. Ecology 90:1063–1072.

Brescovit, A. & C. Rheims. 2000. On the synanthropic species of the genus Scytodes Latreille (Araneae: Scytodidae) of Brazil with synonyms and records of these species in other Neotropical countries. Bulletin of the British Arachnological Society 11:320–330.

Cahill, J.F., S.W. Kembel, E.G. Lamb & P. Keddy. 2008. Does phylogenetic relatedness influence the strength of competition among vascular plants? Perspectives in Plant Ecology, Evolution and Systematics 10:41–50.

Castro, S.A., J.A. Figueroa, M. Muñoz-Schick & F.M. Jaksic. 2005. Minimum residence time, biogeographical origin, and life cycle as determinants of the geographical extent of naturalized plants in continental Chile. Diversity and Distributions 11:183–191.

Cavender-Bares, J., K. Kozak, P. Fine & S. Kembel. 2009. The merging of community ecology and phylogenetic biology. Ecology Letters 12:693–715.

Cekalovic, K. 1976. Catálogo de los Arachnida: Scoriones, Pseudoscorpiones, Opiliones, Acarí, Araneae y Solifugae de la XII Región de Chile, Magallanes. Incluyendo la antártica chilena. Gayana 37:1–108.
Chesson, P. 2000. Mechanisms of maintenance of species diversity. Annual Review of Ecology and Systematics 31:343–366.

Daehler, C. 2001. Darwin’s naturalization hypothesis revisited. American Naturalist 158:324–330.

Darwin, C. 1859. On the Origin of Species. J. Murray, London.

Davis, M.A. 2009. Invasion Biology. Oxford University Press, New York.

Duncan, R.P. & P.A. Williams. 2002. Darwin’s naturalization hypothesis challenged. Nature 417:608–609.

Grunder, D.S. 2005. Biotic resistance to an invasive spider conferred by generalist insectivorous birds on Hawai’i Island. Biological Invasions 7:541–546.

Hamilton, M.A., B.R. Murray, M.W. Cadotte, G.C. Hose, A.C. Baker & C.J. Harris, et al. (2005). Life-history correlates of plant invasiveness at regional and continental scales. Ecology Letters 8:1066–1074.

Hann, S.W. 1990. Evidence for the displacement of an endemic New Zealand spider, _Latrodectus katipo_ Powell by the South African species _Steatoda capensis_ Hamm (Araneae: Theridiidae). New Zealand Journal Zoology 17:295–308.

Hubbell, S.P. 2001. A Unified Neutral Theory of Biodiversity and Biogeography. Princeton University Press, Princeton, New Jersey. Instituto Geográfico Militar. 2010. Atlas Geográfico para la Educación. I.G.M. de Chile. Santiago, Chile.

Kobelt, M. & W. Nentwig. 2008. Alien spider introductions to Europe supported by global trade. Diversity and Distribution 14:273–280.

Kolar, C.S. & D.M. Lodge. 2001. Progress in invasions biology: Predicting invaders. Trends in Ecology and Evolution 16:199–204.

Lambdon, P.W. & P.E. Hulme. 2006. How strongly do interactions with closely-related native species influence plant invasions? Darwin’s naturalization hypothesis assessed on Mediterranean islands. Journal of Biogeography 33:1116–1125.

Levi, H.W. 1967. The theridiid spider fauna of Chile. Bulletin of the Museum of Comparative Zoology 136:1–20.

Levi, H.W. 1968. The spider genera _Gea_ and _Argiope_ in America (Araneae: Araneidae). Bulletin of the Museum of Comparative Zoology 136:319–352.

Levi, H.W. 1974. The orb-weaver genus _Zygia_ (Araneae: Araneidae). Bulletin of the Museum of Comparative Zoology 146:267–290.

Lockwood, J.L., M.F. Hoopes & M.P. Marchetti. 2007. Intraguild predation and successful invasion by introduced ladybird beetles. Annual Review of Ecology, Evolution, and Systematics 17:5–10.

Metcalf, S.Y., C.O. Webb & N. Salamin. 2006. Exotic taxa less related to native species influence plant invasions? _Trachyzelotes_ and _Urozeltotes_ (Araneae, Gnaphosidae). American Museum Novitates 2792:1–30.

Proches, S., J.R.U. Wilson, D.M. Richardson & M. Rejmanek. 2008. Searching for phylogenetic pattern in biological invasions. Global Ecology and Biogeography 17:5–10.

Rabitsch, W. 2011. The hitchhiker’s guide to alien ant invasions. BioControl 56:551–572.

Ramirez, M.J., C.J. Grismando & T. Blick. 2004. Notes on the spider family _Agelenidae_ in Southern South America (Arachnida: Araneae). Revista Ibérica de Aracnologia 9:179–182.

Rejmanek, M. 2000. Invasive plants: approaches and predictions. Austral Ecology 25:497–506.

Rejmanek, M. & D.M. Richardson. 1996. What attributes make some plant species more invasive? Ecology 77:1655–1660.

Ricciardi, A. & M. Mottiar. 2006. Does Darwin’s naturalization hypothesis explain fish invasions? Biological Invasions 8:1403–1407.

Richardson, D.J., P. Pysek, M. Rejmanek, M. Barbour, F. Panetta & C. West. 2000. Naturalization and invasion of alien plants: Concepts and definitions. Diversity and Distributions 6:93–107.

Roth, V.D. 1968. The spider genus _Tegenaria_ in the Western Hemisphere (Agelenidae). American Museum Novitates 2323:1–33.

Sakai, A.K., F.W. Allendorf, J.S. Holt, D.M. Lodge, J. Molosky & J. Wirth, et al. (2001). The population biology of invasive species. Annual Review of Ecology and Systematics 32:305–332.

Santos, A. & M. Gonzaga. 2003. On the spider genus _Oecobius_ in South America (Araneae, Oecobiidae). Journal of Natural History 37:239–252.

Sax, D.F., J.J. Stachowicz, J.H. Brown, J.F. Bruno, M.N. Dawson & S.D. Gaines, et al. (2007). Ecological and evolutionary insights from species invasions. Trends in Ecology & Evolution 22:465–471.

Shigesada, N. & K. Kawasaki. 2001. Biological Invasions: Theory and Practice. Oxford University Press, Oxford, UK.

Shine, C., M. Kettunen, A. P. Genovesi & S. Gollasch. 2009. Technical support to EU strategy on invasive species (IAS) – Recommendations on policy options to control the negative impacts of IAS on biodiversity in Europe and the EU. Final report for the European Commission. Institute for European Environmental Policy (IEEP), Brussels, Belgium.

Simon, E. 1904. Étude sur les arachnides du Chili. Annales de la Société entomologique de Belgique 48:83–114.

Snyder, W.E. & E.W. Evans. 2006. Ecological effects of invasive arthropod generalist predators. Annual Review of Ecology, Evolution, and Systematics 37:95–122.

Snyder, W.E., G.M. Clevenger & S.D. Eigenbrode. 2004. Intraguild predation and successful invasion by introduced ladybird beetles. Oecologia 140:559–565.

StatSoft, I.N.C. 1999. STATISTICA for Windows (Computer program manual). Tulsa, Oklahoma.

Strauss, S.Y., C.O. Webb & N. Salamin. 2006. Exotic taxa less related to native species are more invasive. Proceedings of the National Academy of Sciences of the USA 103:5841–5845.

Taucare-Rios, A. 2011. Primer registro de la viuda marroñona, _Latrodectus geometricus_ (Araneae: Theridiidae) en el norte de Chile. Revista Chilena de Entomología 36:39–42.

Taucare-Rios, A. 2012. Primeros registros de _Smeringopus pallidus_ en Chile (Araneae: Pholcidae). Revista Chilena de Entomología 37:81–85.
Taucare-Ríos, A. 2013a. El género Scytodes (Araneae: Scytodidae) en Chile: diversidad y distribución. Revista Chilena de Historia Natural 86:103–105.

Taucare-Ríos, A. 2013b. Primeros registros de la araña saltarina Hasarius adansonii (Araneae: Salticidae) en Chile. Idesia 31:103–105.

Taucare-Ríos, A. & A. Brescovit. 2011. La araña cangrejo gigante, Heteropoda venatoria (Araneae: Sparassidae: Heteropodinae) en Chile. Boletín de Biodiversidad de Chile 5:39–44.

Taucare-Ríos, A. & G.B. Edwards. 2012. First records of the jumping spider Menemerus semilimbatus (Araneae: Salticidae) in Chile. Peckhania 102:1–3.

Taucare-Ríos, A., A. Brescovit & M. Canals. 2013. Synanthropic spiders (Arachnida: Araneae) from Chile. Revista Ibérica de Aracnología 23:49–53.

Thebaud, C. & D. Simberloff. 2001. Are plants really larger in their introduced ranges? American Naturalist 157:231–236.

Walter, A., P. Bliss & R.F. Moritz. 2005. The wasp spider Argiope bruennichi (Arachnida, Araneidae): ballooning is not an obligate life history phase. Journal of Arachnology 33:516–522.

Williamson, M. 1996. Biological Invasions. Chapman & Hall, London.

Wilson, J.R., D.M. Richardson, M. Rouget, S. Proches, M.A. Amis & L. Henderson, et al. (2007). Residence time and potential range: crucial considerations in modelling plant invasions. Diversity and Distributions 13:11–22.

World Spider Catalog. 2014. World Spider Catalog, Version 15.5. Natural History Museum Bern. Online at http://www.wsc.nmbe.ch/

Manuscript received 18 September 2014, revised 10 December 2014.