Table A.2

The threats posed by the pet trade in alien terrestrial invertebrates in South Africa

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Table Caption:

Terrestrial invertebrate species as well as their SEICAT and EICAT scores. Availability index represents the number of times the species was available when visiting a physical pet store, online pet store or breeder. MC = Minimal concern, MN = minor, MO = moderate, MR = major, and MV = massive. DD refers to Data Deficient.

Species	**Impact type**	**Mechanism**	**Impact scores**	**Confidence**	**Reference**
Achroia grisella	Environmental	Parasitism	MC	H	Zacarin et al. 2004
			MN	L	Nogueira-Neto, 1997
Alphitobius diaperinus	Socio-Economic	Safety	MC	H	Roche et al. 2009
		Material and immaterial assets	MN	H	Turner, 1986
		Safety	MN	M	Savage, 1993
			MC	H	Goodwin, 1996
			MC	H	Strother et al. 2005
			MN	H	Lambkin & Rice 2006
		Material and immaterial assets	MN	H	Ichinose et al. 1980
			MC	L	Templeton et al. 2006
			MN	H	Riley et al. 1997
Blatta lateralis	Socio-Economic	Material and immaterial assets	MN	H	Rios Honda, 2013
			MN	H	Gulmahamad, 1993
Cornu aspersum	Environmental	Transmission of diseases to native species	MN	M	Di Cesare et al. 2013
			MN	L	Giannelliet al. 2014
			MN	M	Köse et al. 2015
			MN	H	Aghazadeh et al. 2015
			MN	H	Butcher & Groove,

					2001
		Parasitism	MN	H	Gracenea & Gonza´lez-Moreno, 2002
	Environmental	Competition	MC	H	Van Bruggen, 1964
	Socio-Economic	Health	MC	H	Butcher & Groove, 2001
		Health	MN	M	Aghazadeh et al. 2015
		Safety	MC	H	Butcher, 2003
		Social, spiritual and cultural practice	MN	H	Pinto-Guillaume, 2002
		Social, spiritual and cultural practice	MC	H	Van Bruggen, 1964
		Material and immaterial assets	MN	H	Pinto-Guillaume, 2002
			MN	M	Pinto-Guillaume, 2008
			MN	H	Castiellejo et al. 1996
Demestedes maculatus	Socio-Economic	Safety	MN	H	Stafford et al. 1988
Drosophila hydei	Environmental	Transmission of diseases to native species	MN	H	Osaka et al. 2013
			MN	L	Ota et al., 1979
		Parasitism	MN	H	Osaka et al. 2013
Gromphadorhina portentosa	Environmental	Transmission of diseases to native species	MN	M	Yoder, 1996

	Socio-Economic	Health	MC	H	Yoder et al. 2007
			MC	H	Morgan et al. 2007
Gryllus assimis	Environmental	Transmission of diseases to native species	MN	L	Luong et al. 2005
Gryllus bimaculatus	Socio-Economic	Health	MC	H	Srinroch et al. 2015
Hottentota saulcyi	Socio-Economic	Health	MO	M	Sagheb et al. 2012
Hottentota tamulus	Socio-Economic	Health	MO	H	Kularatne et al. 2015
			MO	H	Ratnayake et al. 2016
Mesobuthus eupeus	Socio-Economic	Health	MO	M	Sagheb et al. 2012
			MO	H	Sadeghian, 2003
Leiurus quinquestriatus	Socio-Economic	Health	MO	H	Sofer et al. 1991
			MO	H	Sofer & Gueron, 1988
Periplaneta americana	Socio-Economic	Health	MC	H	Lemos et al. 2006
			MN	H	Santos et al. 1999
		Material and immaterial assets	MN	H	Lee et al. 1993
		Health	MC	H	Frishman & Alcamo, 1977
Phoetalia pallida	Environmental	Transmission of diseases to native species	MN	L	Clopton, 2010
Tenebrio molitor	Environmental	Parasitism	MC	H	Ratcliffe, 2008
			MC	H	Favero et al. 2013
	Socio-Economic	Health	MN	H	Freye et al. 1996
Scolopendra subspinipes	Socio-Economic	Health	MO	H	Veraldi et al. 2014
Zophobas morio	Socio-Economic	Health	MN	H	Bregnbak et al. 2013

Reference

Aghazadeh, M., Reid, S. A., Aland, K. V., Restrepo, A. C., Traub, R. J., McCarthy, J. S., & Jones, M. K. (2015). A survey of Angiostrongylus species in definitive hosts in Queensland. *International Journal for Parasitology: Parasites and Wildlife*, 4, 323-328.

Bregnbak, D., Friis, U. F., Zachariae, C., Menne, T., & Johansen J. D. (2013). Protein contact dermatitis caused by worms and insects used to feed exotic birds. *Contact Dermatitis*, 70, 63–66.

Butcher, A. R., & Grove, D. I. (2001). Description of the life-cycle stages of Brachylaima cribbi n. sp. (Digenea: Brachylaimidae) derived from eggs recovered from human faeces in Australia. *Systematic Parasitology*, 49, 211–221.

Castiellejo, J., Seijas, I., & Villoch, F. (1996). Slug and snail pests in Spanish crops and their economical importance. Slug & snail pests in agriculture pp, 327-332.

Clopton, R. E. (2010). Protomagalhaensia cerastes n. sp. (Apicomplexa: Eugregarinida: Blabericolidae) Parasitizing the Pallid Cockroach, Phoetalia pallida (Dictyoptera: Blaberidae). *Comparative Parasitology*, 77, 117-124.

Di Cesare, A., Crisi, A. E., Di Giulio, E., Veronesi, F., di Regalbono, A. F., Talone, T., & Traversa, D. (2013). Larval development of the feline lungworm Aelurostrongylus abstrusus in *Helix* aspersa. *Parasitological Restoration*, 112, 3101–3108.

Favero, K., Pereira, F.F., De oliveira, H. N., & Zanuncio, J. C. (2013). Tenebrio molitor (Coleoptera: Tenebrionidae) as an alternative host for the parasitoid Trichospilus diatraeae (Hymenoptera: Eulophidae). *Revista Colombiana*, 39.

Freye, H. B., Esch, R. E., Litwin, C. M., & Sorkin, L. (1996). Anaphylaxis to the ingestion and inhalation of Tenebrio molitor (mealworm) and Zophobas morio (superworm). *Allergy and Asthma Proceedings*, 17, 215-219.

Frishman, A. M., & Alcamo, I. E. (1977). Domestic cockroaches and human bacterial disease. *Pest Control*, 45, 16-20.

Giannelli, A., Ramos, R. A. N., Annoscia, G., Di Cesare, A., Colella, V., Brianti, E., Dantas-Torres F., Mutafchiev, Y., & Otranto, D. (2014). Development of the feline lungworms Aelurostrongylus abstrusus and Troglostrongylus brevior in Helix aspersa snails. *Parasitology*, 141, 563–569

Goodwin, M. A. (1996). Transmission of Eimeria, viruses, and bacteria to chicks: Darkling beetles (*Alphitobius diaperinus*) as a vector of pathogens. *Applied Poultry Science*, 5, 51-55.

Gracenea & Gonza´lez-Moreno (2002). life cycle of *Brachylaima mascomai* n. sp. (trematoda: brachylaimidae), a parasite of rats in the Llobregat Delta (Spain). *Journal of Parasitology*, 88, 124-133.

Gulmahamad, H. (1993). Tracking the Turkestan cockroach. *Pest Control Technology*, 21: 112-114.

Ichinose, T., Shibazaki, S., & Ohta, M. (1980). Studies on the biology and mode of infestation of the tenebrionid beetle, *Alphitobius diaperinus* Panzer, harmful to broiler-chicken houses. *Japanese Journal of Applied Entomology and Zoology*, 24, 167-174.

Köse, M., Eser, M., Kartal, K., & Bozkurt, M. F. (2015). Infections of Larval Stages of Dicrocoelium dendriticum and Brachylaima sp. in Brown Garden Snail, Helix aspersa, in Turkey. *Korean Journal of Parasitology,* 53, 647-651.

Kularatne, S. A. M., Dinamithra, N. P., Sivansuthan, S., Weerakoon, K. G. A. D., Thillaimpalam, B., Kalyanasundram, V., & Ranawana, K. B. (2015). Clinico-epidemiology of stings and envenoming of Hottentotta tamulus (Scorpiones: Buthidae), the Indian red scorpion from Jaffna Peninsula in northern Sri Lanka. *Toxicon*, 93, 85-89.

Lambkin, T. A., & Rice, S. J. (2006). Baseline Responses of Alphitobius diaperinus (Coleoptera: Tenebrionidae) to Cyfluthrin and Detection of Strong Resistance in Field Populations in Eastern Australia. *Journal of Economic Entomology*, 99, 908-913.

Lee, C. Y., Chong, N. L., & Yap, H. H. (1993). Short communication; A study on domiciliary cockroach infestation in Penang, Malaysia. *Journal of Bioscience*, 4, 95-98.

Lemos, A. A., Lemos, J. A., Prado, M. A., Pimenta, F. C., Gir, E., Silva, H. M., & Silva, H. R. R. (2006). Cockroaches as carriers of fungi of medical importance. *Mycoses*, 49:23–25.

Luong, L. T., Kortet, R., & Hedrick, A. V. (2005). Prevalence and intensity of Cephalobium microbivorum (Nematoda: Diplogasterida) infection in three species of Gryllus field crickets. *Parasitology Research*, 97, 336–339.

Morgan, M. S., Arlian, L. G., Bernstein, J. A., & Yoder, J. A. (2007). Allergenicity of the Madagascar hissing cockroach. *Ann Allergy Asthma Immunol,* 98, 258–261.

Nogueira-neto, P. (1997). Vida ecriaCao de albehas indigenas sem ferroo. Editora Nogueirapis; Sao Paulo, Brazil; 445 pp.

Osaka, R., Watada, M., Kageyama, D., & Nomura, M. (2013). Detection of Spiroplasma from the mite Macrocheles sp. (Acari; Macrochelidae) ectoparasitic to the fly Drosophila hydei (Diptera; Drosophilidae): a possible route of horizontal transmission? *Symbiosis*, 60, 79–84.

Ota, T., Kawabe, M., Oishi, K. & Poulson, D. F. (1979). Non-male-killing spiroplasmas in *Drosophila hydei*. *The Journal of Heredity*, 70, 211-213.

Pinto-Guillaume, E. M. (2002). Mollusks from the Villa of Livia at Prima Porta, Rome: The Swedish Garden Archaeological. *American Journal of Archaeology*, 106, 37-58.

Pinto-Guillaume, E. M. (2008). Molluscs from the Villa of Livia revisited. The Archaeo+Malacology Group Newsletter 13.

Ratcliffe, B. C. (2008). Tenebrio molitor Linnaeus (Cole?ptera: Tenebrionidae), a New Alternative Host to Rear the Pupae Parasitoid Palmistichus elaeisis Delvare & LaSalle (Hymenoptera: Eulophidae. *The Coleopterists Bulletin*, 62, 64-66.

Ratnayake, R. M. U. K. B., Kumanan, T., & Selvaratnam, G. (2016). Acute myocardial injury after scorpion (Hottentotta tamulus) sting. *Ceylon Medical Journal,* 61, 86-87.

Riley, D. G., Douce, G. K. & McPherson, R. M. (1997). Summary of losses from insect damage and costs of control in Georgia in 1996. Georgia Agricultural Experiment Stations Special Publication 91.

Rios, L. A., & Honda, J. Y. (2013). New records for Blatta lateralis (Walker 1868) (Blattaria: Blattidae) in California. *Pacific Coast Entomological Society*, 89, 120-121.

Roche, A. J., Cox, N. A., Richardson, L. J., Buhr, R. J., Cason, J. A., Fairchild, B. D., & Hinkle, N. C. (2009). Transmission of Salmonella to broilers by contaminated larval and adult lesser mealworms, Alphitobius diaperinus (Coleoptera: Tenebrionidae). *Poultry Science*, 88, 44–48.

Sadeghian, H. (2003). Transient ophthalmoplegia following envenomation by the scorpion *Mesobuthus eupeus.* *Neurology*, 60, 346–347.

Sagheb, M. M., Sharifian, M., Moini, M., & Sharifian, A. H. (2012). Scorpion bite prevalence and complications: report from a referral centre in southern Iran. *Tropical Doctor*, 42, 90–91.

Santos, A. B. R., Chapman, M. D., Aalberse, R. C., Vailes, L. D., Ferriani, V. P. L., Oliver, C., Rizzo, M. C., Naspitz, C. K., & Arruda, L. K. (1999). Cockroach allergens and asthma in Brazil: Identification of tropomyosin as a major allergen with potential cross-reactivity with mite and shrimp allergens. *Journal of allergy and clinical immunology*, 104, 329-337.

Savage, S. (1993). Darkling beetles cannot be eradicated, just controlled. *Poultry Times lS*, 6, 11-13.

Sofer, S., & Gueron, M. (1988). Respiratory failure in children following envenomation by the scorpion *Leiurus quinuestriatus*: hemodynamic and neurological. *Toxicon*, 26, 931-939.

Sofer, S., Shalev, H., Weizman, Z., Shahak, E., & Gueron, M. (1991). Acute pancreatitis in Children following envenomation by yellow scorpion *Leiurus quinuestriatus. Toxicon,* 29, 125-128.

Srinroch, C., Srisomsap, C., Chokchaichamnankit, D., Punyarit, P., & Phiriyangkul, P. (2015). Identification of novel allergen in edible insect, Gryllus bimaculatus and its cross-reactivity with Macrobrachium spp. Allergens. *Food Chemistry,* 184, 160–166.

Stafford, K. C., Collison, C. H., Burg, J. G., & Cloud, J. A. (1988). Distribution and monitoring lesser mealworms, hide beetles and other fauna in high-rise caged-layer poultry houses. *Journal of Agricultual Entomology*, 5, 89-101.

Strother, K. O., Steelman, C. D., & Gbur, E. E. (2005). Reservoir Competence of Lesser Mealworm (Coleoptera: Tenebrionidae) for Campylobacter jejuni (Campylobacterales: Campylobacteraceae). *Journal of Medical Entomology*, 42, 42-47.

Templeton, J. M., De Jong, A. J., Blackall, P. J., & Miflin, J. K. (2006). Survival of Campylobacter spp. in Darkling Beetles (Alphitobius diaperinus) and Their Larvae in Australia. *Applied and Environmental Microbiology*, 72, 7909–7911.

Turner, E. C. (1986). Structural and litter pests. *Poultry Science*, 65, 644–648.

Van Bruggen, A. C. (1964). The distribution of introduced mollusc species in Southern Africa. Series of Miscellaneous publication 11.

Veraldi, S., Cuka, E., & Gaiani F. (2014). Scolopendra bites: a report of two cases and review of the literature. *International journal of dermatology*, 53, 869–872.

Yoder, J. A., Benoit, J. B., Condon, M. R., & Zettler, L. W. (2012). Competition in vitro among fungi acquired from the exoskeleton of the giant Madagascar hissing-cockroach, Gromphadorhina portentosa, and its relevance to human health. *Fungal ecology*, 5, 490-498.

Yoder, J. A., Glenn, B. D., Benoit, J. B, Zettler, L. W. (2007). The giant Madagascar hissing-cockroach (Gromphadorhina portentosa) as a source of antagonistic moulds: concerns arising from its use in a public setting. *Mycoses,* 51, 95–98.

Zacarin, G. G., Gobbi, N., Chaud-Netto, J. (2004). Preferência de Apanteles galleriae Wilkinson (Hymenoptera: Braconidae) porGalleria mellonella (L.) ou Achroia grisella (Fabricius) (Lepidoptera: Pyralidae). *Neotropical Entomology,* 33, 065-070.