

# A radiation of the ornate Caribbean ‘smiley-faced spiders’, with descriptions of 15 new species (Araneae: Theridiidae, *Spintharus*)

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Although the Caribbean region is recognized as a major biodiversity hotspot, many megadiverse groups remain taxonomically understudied. The ornate spiders of the genus *Spintharus* Hentz, 1850 (Theridiidae, Araneae) are a good example where taxonomic boundaries have remained unclear. The genus shows profuse habitus and genitalic variation in the Caribbean and has distinct colour patterns that rapidly degrade in ethanol. The leading theridiid taxonomist of the last six decades (Herbert W. Levi) therefore concluded that the morphological diversity of Caribbean *Spintharus* was, with the evidence available at the time, best characterized as intraspecific variation. The first molecular study, however, rejected the ‘single widespread species’ hypothesis, rather indicating multiple short-range endemics. This paper describes and diagnoses 15 new species based on the combination of molecular and morphological data, including *S. davidattenboroughi* sp. nov., *S. barackobamai* sp. nov., *S. michelleobamae* sp. nov., *S. davidbowiei* sp. nov., *S. leonardodicaprioi* sp. nov. and *S. berniesandersi* sp. nov. Much Caribbean diversity may be similarly ‘hidden’ by existing taxonomical hypotheses; clearly, more focus is needed on the taxonomy of megadiverse groups. The implications of integrated taxonomy dramatically alter conservation biology when a single widespread species is instead found to represent multiple short-range endemics. Our goal here is thus to update *Spintharus* taxonomy and discuss the implications of the newly found diversity for both biodiversity research and conservation.

ADDITIONAL KEYWORDS: biogeography – species delimitation – taxonomy.

## INTRODUCTION

Old warm-climate archipelagos typically harbour high biodiversity and endemism due to various factors where the interplay among dispersal ability, colonization and gene flow is key (e.g. Diamond & Mayr, 1976; Heaney, Walsh & Peterson, 2005; Cowie & Holland, 2006; McPeck & Brown, 2007; Whittaker, Triantis & Ladle, 2008; Losos & Ricklefs, 2010; Agnarsson & Kuntner, 2012; Claramunt *et al.*, 2012; Gillespie *et al.*, 2012; Agnarsson, Cheng & Kuntner, 2014). The

Caribbean region contains numerous endemic radiations of a wide variety of taxa (Ricklefs & Bermingham, 2008). Mounting evidence suggests that many of the highly diverse taxa colonized early in the history of the islands. Recent studies on a variety of taxa, for example arachnids [L. Chamberland, A. McHugh, S. Kechejian, G. Binford, J. Bond, J. Coddington, G. Dolman, C. Hamilton, M. Harvey, M. Kuntner, I. Agnarsson, unpubl. data (Deinopidae); Crews & Gillespie, 2010; McHugh *et al.*, 2014; Dziki *et al.*, 2015; Esposito *et al.*, 2015; I. Petersen, J. Coddington, I. Agnarsson, G. Binford, unpubl. data (*Loxosceles*)]; freshwater fishes (Hulseley, Keck & Hollingsworth, 2011; Rican *et al.*, 2013; Weaver *et al.*, 2016); amphibians (Crawford & Smith, 2005; Moen, Smith & Wiens, 2009; Alonso, Crawford

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& Bermingham, 2012); and insects (Wahlberg, 2006; Matos-Maravi *et al.*, 2014) corroborate the importance of the 35–33 Mya GAARlandia land bridge that is hypothesized to have linked the Greater Antilles with the South American continent (Iturralde-Vinent & MacPhee, 1999; Iturralde-Vinent, 2006). Additional evidence comes from fossil data, including several mammal groups (Horovitz & MacPhee, 1999; Iturralde-Vinent & MacPhee, 1999; MacPhee & Flemming, 2003; Davalos, 2004; Velez-Juarbe *et al.*, 2014). The subsequent breakup of GAARlandia resulted in barriers that limited gene flow and across which many groups radiated (Ricklefs & Bermingham, 2008). The Caribbean is thus well characterized as ‘a laboratory of biogeography and evolution...’ (Ricklefs & Bermingham, 2008) and has been studied in detail in numerous seminal papers on the formation of ecological and evolutionary radiations (e.g. Losos, 1996; Losos & DeQueiroz, 1997), and the processes of speciation and biogeography of various taxa (see e.g. references above). However, as the number of biogeographical studies continues to grow rapidly, the taxonomy of the organisms often lags behind, especially for megadiverse arthropod lineages. Knowledge of species is important to our understanding of biodiversity and conservation biology—providing critical data on biodiversity hotspots, such as the Caribbean.

Arachnid taxonomy has a long and active tradition in the Caribbean, especially in Cuba. However, revisionary taxonomic work on Caribbean spiders has been sporadic since early seminal papers by Bryant and Petrunkevitch in the 1930s–1940s (e.g. Petrunkevitch, 1926, 1928, 1929, 1930a, 1930b; Bryant, 1940, 1942a, b, 1945, 1947a, b, 1948, 1950) and Levi’s numerous revisions of Araneidae, Tetragnathidae and Theridiidae of the New World (e.g. Levi, 1954a, b, 1955a, b, 1957, 1959, 1963a, b, 1985, 1992, 1995, 2005, 2008). More recent efforts are a mixture of morphological revisions, for example goblin spiders (Platnick *et al.*, 2011, 2012), huntsman spiders (Rheims & Alayón, 2016), and *Cyrtognatha* (Dimitrov & Hormiga, 2009); molecular phylogeny-based revisions, for example Salticidae (Zhang & Maddison, 2012), *Selenops* (Crews & Gillespie, 2010; Crews *et al.*, 2010; Crews, 2011) and *Modisimus* (Huber, Fischer & Astrin, 2010); and smaller taxonomic amendments (e.g. Bloom *et al.*, 2014; Sánchez-Ruiz, Brescovit & Alayón, 2015). Almost no taxonomic work on Caribbean cobweb spiders has been conducted since Levi’s work in the 1960s. In his revisions of *Spintharus*, Levi (1954a, 1963a) highlighted the impressive morphological diversity of the genus, but was unable to find a geographically structured pattern of clearly diagnostic features. On his second scrutiny of the genus, he concluded that ‘on reexamining a few specimens, I began to think that I had confused several species in my previous revision

and that the specimens could easily be sorted out into three species. Reexamination of larger collections, however, reestablished my previous observation that the genitalia of *Spintharus* are variable and that there are at most two species.’ (Levi, 1963a: 223). With no subsequent changes, the genus contains only two New World species of which *Spintharus gracilis* (Keyserling, 1886) is restricted to Brazil and *Spintharus flavidus* (Hentz, 1850) that occurs from northern North America to southern South America, including many Caribbean islands. A third species from Asia currently placed in *Spintharus*, *S. argenteus* (Dyal, 1935), is clearly misplaced with unknown affinities (see below and Levi, 1953: 79). *Spintharus flavidus*, as currently circumscribed, is highly polymorphic in colour patterns and genitalia.

The subfamily Spintharinae has received some phylogenetic attention recently. The genus was present in the higher-level phylogenetic analyses of Agnarsson (2004) based on morphology, and the molecular studies of Arnedo *et al.* (2004) and Liu *et al.* (2016). An analysis of morphological data, focusing on spintharines, was then presented by Durán-Barrón, Rosas & Contreras-Ramos (2013). These studies have strongly supported the monophyly of Spintharinae, but do not agree on the exact placement of *Spintharus*. Based on molecular data, *Spintharus* is probably sister to *Chrosiothes* (Liu *et al.*, 2016), but morphology is ambiguous as to its placement (Durán-Barrón *et al.*, 2013). The first species-level molecular phylogenetic data for *Spintharus* was published only recently by Dziki *et al.* (2015), based on specimens freshly sampled throughout the Caribbean and on neighbouring continents. These data strongly rejected Levi’s ‘widespread species’ hypothesis and instead suggested that Levi’s ‘*Spintharus flavidus*’ hypothesis contains multiple short-range endemics both on the Caribbean islands as well as on the surrounding continents. Dziki *et al.* (2015) concluded that at least 16 new species were present in their samples, all of which occur only in one or a few nearby localities, and all are restricted to single islands or a small mainland area. Given these findings and limited mainland sampling, a thorough survey of the genus throughout the Americas will probably yield numerous additional species. Hence, a revision of the genus is not timely. Instead, we here opportunistically describe the new species discovered by the Caribbean Biogeography project ([islandbiogeography.org](http://islandbiogeography.org)) – the CarBio team (Dziki *et al.*, 2015). We believe it is urgent to reflect such findings, as quickly as possible, in the taxonomy of the group, so as to reflect current knowledge of biodiversity, inform conservation biology and facilitate further research on the group. With this paper, we aim to highlight the diversity of the genus, its potential for biogeographical analyses and its

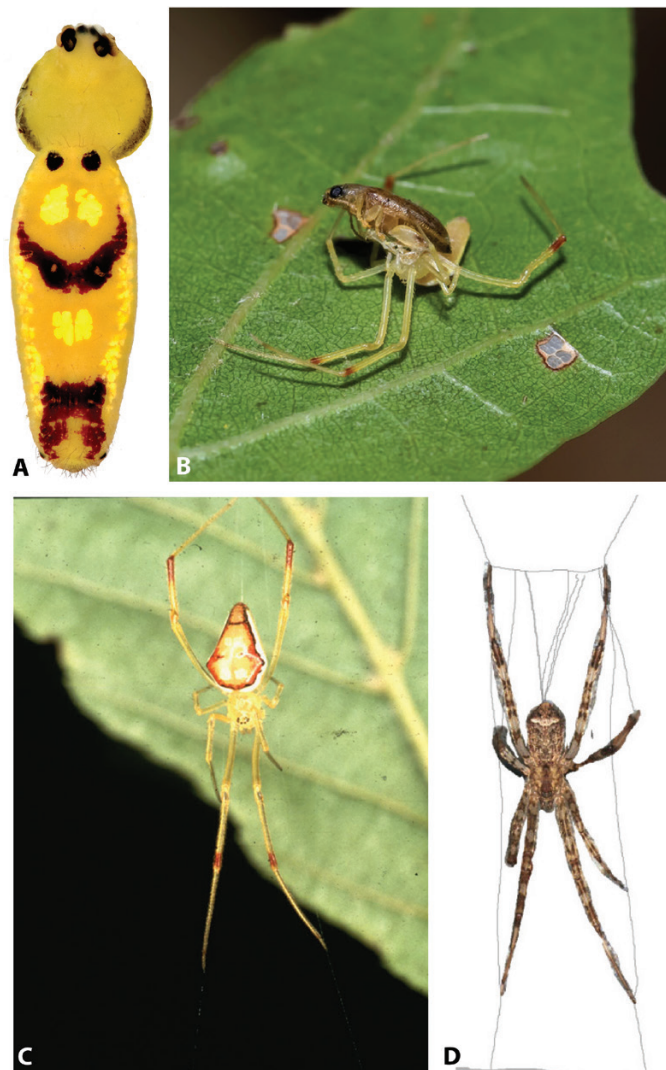
importance for biodiversity and conservation biology. We also hope to inspire further studies of these charismatic spiders across their vast range in the Americas where Central and South America, in particular, can be expected to harbour a rich diversity of *Spintharus*.

## MATERIAL AND METHODS

### STUDY ORGANISM

We here adopt the name ‘smiley-faced spiders’ for *Spintharus* due to the resemblance of a smiley face on the abdomen of some species (e.g. Fig. 1A), similar to the ‘happy face’ spiders of Hawaii (*Theridion*

*grallator*). The taxonomic hypothesis *Spintharus flavidus* Hentz, 1850 circumscribes a widespread spider species found throughout the Caribbean and from northern North America to Brazil and Argentina (Levi, 1954a, 1963a). The other species of the genus, *S. gracilis*, is restricted to Brazil (Levi, 1954a, 1963a). A third species *S. argenteus* (Dyal, 1935) from Pakistan is clearly misplaced in the genus based on its original description (Levi, 1954a). Dziki *et al.* (2015) suggest this may be a tetragnathid, but the original description and illustrations are too poor to assess its proper placement. Given the unavailability of the specimen, we here propose this species as a nomen dubium. *Spintharus* (Hentz, 1850) are typically found in leaf



**Figure 1.** A, the inspiration for the vernacular name smiley-faced spiders, a smiley *Spintharus ralli* sp. nov., from Puerto Rico. B, female *S. flavidus* with prey, photograph by Bonnie Ott. C, female *S. flavidus* in an (barely visible) H-shaped web. Lines held with the first pair of legs that go to the substrate are faintly visible, photograph by Mark Stowe. The web is similar to the web of the related genus *Episinus*, see D. D, *Episinus maculipes* in its H-web, by Ed Nieuwenhuys. Images reproduced with permission from authors.



litter or the undersides of leaves in low vegetation where they construct small and difficult to observe webs. These webs are simplified ‘H-webs’ (Levi, 1963a; Agnarsson, 2004) where the spider is in the middle facing down towards the gluey droplets at the base of the web (Fig. 1D). The genus belongs to the subfamily Spintharinae (Agnarsson, 2004), also containing *Brunepisinus* (Yoshida & Koh, 2011), *Chrosiothes* (Simon, 1894), *Episinus* (Walckenaer, 1809), *Janula* (Strand, 1932), *Moneta* (O. Pickard-Cambridge, 1870), *Neopisinus* (Marquez, Buckup & Rodrigues, 2011), *Pycnoepisinus* (Wunderlich, 2008), *Stemmops* (O. Pickard-Cambridge, 1894) and *Thwaitesia* (O. Pickard-Cambridge, 1881), see Agnarsson & Veve (2015) and Agnarsson & Levi (2017). The subfamily is cosmopolitan in temperate to tropical habitats, while the genus *Spintharus* is restricted to the Americas. A fossil specimen in Dominican amber supports a long history of the genus in the Caribbean, and Dziki *et al.* (2015) found evidence for a single Caribbean colonization event corresponding in time to the GAARlandia land (35–33 Mya).

#### SPECIMEN SAMPLING AND DNA EXTRACTION AND ASSEMBLY

The CarBio team ([www.islandbiogeography.org](http://www.islandbiogeography.org)) collected specimens from Cuba, the Dominican Republic, Puerto Rico, Jamaica, the Lesser Antilles, Florida, South Carolina, Costa Rica, Mexico and Colombia between 2011 and 2016. All specimens were collected under appropriate permits: **Puerto Rico**, DRNA: 2011-IC-035 (O-VS-PVS15-SJ-00474-08042011); **Jamaica**, NEPA, reference number #18/27; **USA**, USDI National Park Service, EVER-2013-SCI-0028; **Costa Rica**, SINAC, pasaporte científico no 05933, resolución no 019-2013-SINAC; **Cuba**, Departamento de Recursos Naturales, PE 2012/05, 2012003 and 2012001; **Dominican Republic**, Ministerio de Medio Ambiente y Recursos Naturales, no 0577, **Mexico**, SEMARNAT scientific collector permit FAUT-0175 issued to Dr Oscar Federico Francke Ballve, Oficio no SGPA/DGVS/10102/13; **Colombia**, Autoridad Nacional de Licencias Ambientales, 18.497.666 issued to Alexander Gómez Mejía; **Saba**, the Executive Council of the Public Entity Saba, no 112/2013; **Martinique**, Ministère de L’Écologie, du Développement Durable, et de L’Énergie; **Nevis**, Nevis Historical & Conservation Society, no F001; **Barbados**, Ministry of Environment and Drainage, no 8434/56/1 Vol. II. We used standard protocols for aerial search, beating, sifting and cryptic methods (Coddington *et al.*, 1991, 2009). Spiders were immediately fixed in 95% ethanol and stored at –20 °C upon return to the lab (UVM Natural History Museum). Holotypes will be deposited at the USNM (Smithsonian Institution).

#### PHYLOGENETIC AND BIOGEOGRAPHICAL ANALYSES

Phylogenetic methodology and biogeographical analyses are described in Dziki *et al.* (2015). We here use the results of those analyses as a basis for species delimitation and descriptions (see below).

#### SPECIES DELIMITATION, DISTRIBUTION AND PHOTO-DOCUMENTATION

We calculated distances among putative species-level clades suggested by the phylogenetic analyses of Dziki *et al.* (2015) and the barcoding analysis of the *COI* data using MEGA6 (table S1, table 1 from Dziki *et al.* 2015) for details. In sum, the phylogenetic results and genetic distance measures, plus locality information (regionally monophyletic groups), provide initial species hypotheses. Various species delimitation methods were then used to help estimate number of species in this radiation using *COI* or the three loci data set/tree depending on the method. We used the species delimitation plugin in Geneious 8.1.5 (Kearse *et al.*, 2012) to estimate species limits under Rosenberg’s reciprocal monophyly P(AB) (Rosenberg, 2007) and Rodrigo’s P(RD) method (Rodrigo *et al.*, 2008). We also estimated the probability of population identification of a hypothetical sample based on the groups being tested [P ID(Strict) and P ID(Liberal)]. The genealogical sorting index (gsi) statistic (Cummings, Neel & Shaw, 2008) was calculated using the gsi web-server (<http://genealogicalsorting.org>) on the estimated tree and an assignment file that contained the same user specified groups identified in the Geneious plugin. Finally, we used a single locus Bayesian implementation (bPTP) of the Poisson tree processes model (Zhang *et al.*, 2013) to infer putative species boundaries on a given single locus phylogenetic input tree available on the web-server (<http://species.hits.org/ptp/>). The analysis was run as a rooted tree from the MrBayes analysis, with outgroups removed for 100,000 generations with 10% burn-in removed. For summary of species delimitation results, see Table 1.

For each putative molecular species-level clade, representatives from all localities were chosen for taxonomic photography. The spiders were positioned in Germ-X hand sanitizer (65% ethanol) and covered in 95% ethanol. The photographs were taken with the Visionary Digital BK Laboratory System, using a Canon 5D camera, a 65-mm macro zoom lens. Photo stacks of 30–50 slices were then compiled using the program Helicon Focus 5.3. The image was then edited in Photoshop CS6 to balance light quality, adjust brightness, remove background blemishes and provide a scale. We opted not to invest in scientific illustrations at this point, as the rather simple yet variable genitalia would (Fig. 2I–K) add little information, given the lack of diagnostic genitalic characters, as highlighted

**Table 1.** Summary of species delimitation

Sp Hyp.	Mono	D Intra	D Inter	Dtra/ Dter	P ID(Strict)	P ID(Liberal)	P (AB)	gsi	bPTP	Sp congru.	Sp cons.
Mex 1	Yes	0.008	0.041	0.19	0.66 (0.49, 0.84)	0.90 (0.75, 1.0)	3.10E-04	1	Y	1	1
USA 1	Yes	n/a	0.005	n/a	n/a	0.96 (0.83, 1.0)	0.02	0.61	N	2	2
USA 3	Yes	0.001	0.012	0.12	0.71 (0.54, 0.89)	0.94 (0.80, 1.0)	0.17	1	N		
USA 2	No	0.005	0.005	1.01	0.33 (0.22, 0.44)	0.68 (0.61, 0.74)	NA	0.83	N		
Mex 2	Yes	0.001	0.063	0.02	0.58 (0.43, 0.73)	0.97 (0.82, 1.0)	1.60E-05	1	Y	3	3
Jam	Yes	0.003	0.059	0.05	0.76 (0.58, 0.93)	0.98 (0.84, 1.0)	4.20E-04	1	Y	4	4
Grenada	Yes	0.002	0.014	0.15	0.52 (0.36, 0.67)	0.89 (0.74, 1.0)	0.05	1	Y	5	5
St Lucia	Yes	0.003	0.014	0.2	0.66 (0.48, 0.84)	0.90 (0.75, 1.0)	0.05	1	Y	6	
St Kitts	Yes	0.003	0.01	0.32	0.58 (0.40, 0.75)	0.82 (0.68, 0.97)	0.02	0.83	Y	7	6
PR	Yes	0.002	0.01	0.21	0.65 (0.47, 0.83)	0.89 (0.74, 1.0)	0.02	1	Y		
Dom	Yes	n/a	0.006	n/a	n/a	0.96 (0.83, 1.0)	0.1	1	Y	8	7
CU1	Yes	0.002	0.043	0.04	0.77 (0.59, 0.94)	0.99 (0.84, 1.0)	5.80E-04	1	Y	9	8
CU2	Yes	0.001	0.021	0.07	0.75 (0.57, 0.92)	0.97 (0.83, 1.0)	1.85E-03	1	Y	10	9
CU3	Yes	0.006	0.021	0.29	0.81 (0.70, 0.91)	0.93 (0.86, 0.99)	1.85E-03	1	Y	11	10
DR1	Yes	0.004	0.022	0.18	0.67 (0.49, 0.85)	0.90 (0.76, 1.0)	1.80E-04	1	Y	12	11
DR2	Yes	0.003	0.02	0.14	0.88 (0.77, 0.99)	0.96 (0.90, 1.0)	4.40E-05	1	Y	13	12
DR3	Yes	0.003	0.016	0.2	0.65 (0.48, 0.83)	0.89 (0.75, 1.0)	0.01	1	Y	14	13
DR4	Yes	0.003	0.016	0.18	0.75 (0.60, 0.89)	0.94 (0.83, 1.0)	0.01	0.83	Y	15	
CU4	Yes	0.003	0.011	0.3	0.73 (0.61, 0.86)	0.93 (0.83, 1.0)	1.06E-03	1	Y	16	14
CU5	Yes	0.004	0.011	0.38	0.61 (0.47, 0.75)	0.87 (0.76, 0.98)	1.06E-03	0.83	Y		
CU6	Yes	0.002	0.019	0.09	0.73 (0.56, 0.91)	0.96 (0.81, 1.0)	0.01	0.92	Y	17	15
CU7	Yes	0.004	0.021	0.2	0.74 (0.59, 0.88)	0.93 (0.83, 1.0)	0.01	1	Y	18	16

Species hypotheses (first column) represent coloured and numbered clades shown in Figure 1. The various measures of distance, and of other of isolation and exclusivity metrics of these clades follow, including: genetic distance within putative species (D intra), genetic distance to the nearest putative species (D inter), the probability of population identification of a hypothetical sample based on the groups being tested (P ID(Strict) and P ID (Liberal)), Rosenberg's reciprocal monophyly [P (AB)], the genealogical sorting index (gsi) and a single locus Bayesian implementation of the Poisson tree processes model (bPTP). Sp congru. refers to species hypothesis that is congruent with all methods, and Sp cons. is our conservative estimate of actual species richness based on agreement among all methods and GSI > 85 and > 2% mtDNA sequence divergence.

by Levi's (1954a, 1963a) work, but would dramatically delay dissemination of taxonomic information. A thorough revision of the genus throughout its range is necessary to determine if variation in genitalia will prove informative for species diagnoses, in which case detailed illustrations will be of much value.

We used the online program GPS Visualizer (<http://www.gpsvisualizer.com>) to plot localities (Fig. 1).

We designate holotypes, all of which will be deposited at NMNH Smithsonian. All other specimens will be deposited at the UVM Natural History Museum. Note that under 'variation' sections, we list measurements of the largest and the smallest specimens we have available of each species, and only those specimens, plus holotype, were measured.

## RESULTS

### SPECIMEN SAMPLING AND DNA EXTRACTION AND ASSEMBLY

Of the 195 individuals chosen for DNA work, 186 yielded quality DNA and 175 were successfully amplified for

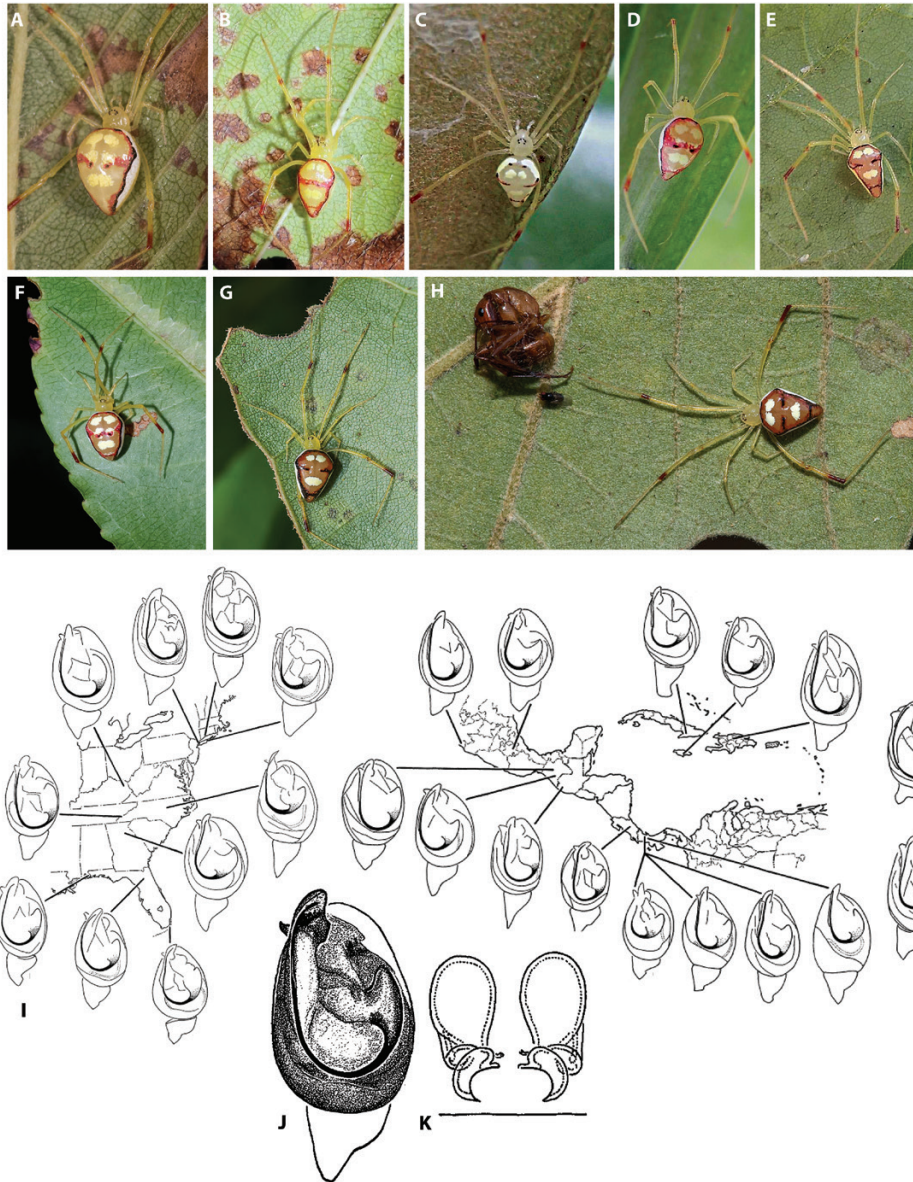
*COI*. The subset of 186 taxa that was chosen for additional sequencing yielded 180 16S sequences and 79 ITS2 sequences, representing all major clades. In all, the concatenated matrix contains 1572 nucleotides of which 668 are *COI*, 682 are 16S, and 312 are ITS2.

### PHYLOGENETICS

The current phylogeny is depicted in Figure 3, and see Dziki *et al.* (2015) for detail of phylogenetic analyses and results.

### SPECIES DELIMITATION, DISTRIBUTION AND PHOTO-DOCUMENTATION

All the 15 new species are short-range endemics without any range overlap suggesting allopatric speciation (Dziki *et al.*, 2015). Most are restricted either to small continental areas or to single islands. Only two species occur on two or more islands, but in each case, the islands are proximate. *Spintharus ralli* sp. nov. (see Fig. 3) has genetically distinct populations on St. Kitts and Nevis, and in Puerto Rico,



**Figure 2.** A–F, variation in Levi’s ‘widespread *Spintharus flavidus* hypothesis’, within the USA. A–H, female habitus, all spiders (except H) oriented carapace up for ease of comparison. In their web, they face carapace down (see Fig. 1). A, from Maryland (photograph by Mark Etheridge); B, from Pennsylvania (photograph by Mark Moore); C–E, from Kentucky (photographs by Lisa Bentley); F, from Maryland; G–H from West Virginia (H with spider next to a wrapped prey item, an ant) (photographs by Bonnie Ott). Photographs from BugGuide.net, or other online sources, reproduced with permission from authors. I, variation in male palps across North and Central America, and the West Indies, reproduced from Levi (1963a). J, illustration of male palp of ‘typical’ eastern USA *S. flavidus* (from Levi, 1963a). K, illustration of female genitalia from eastern USA *S. flavidus* (from Levi, 1963a).

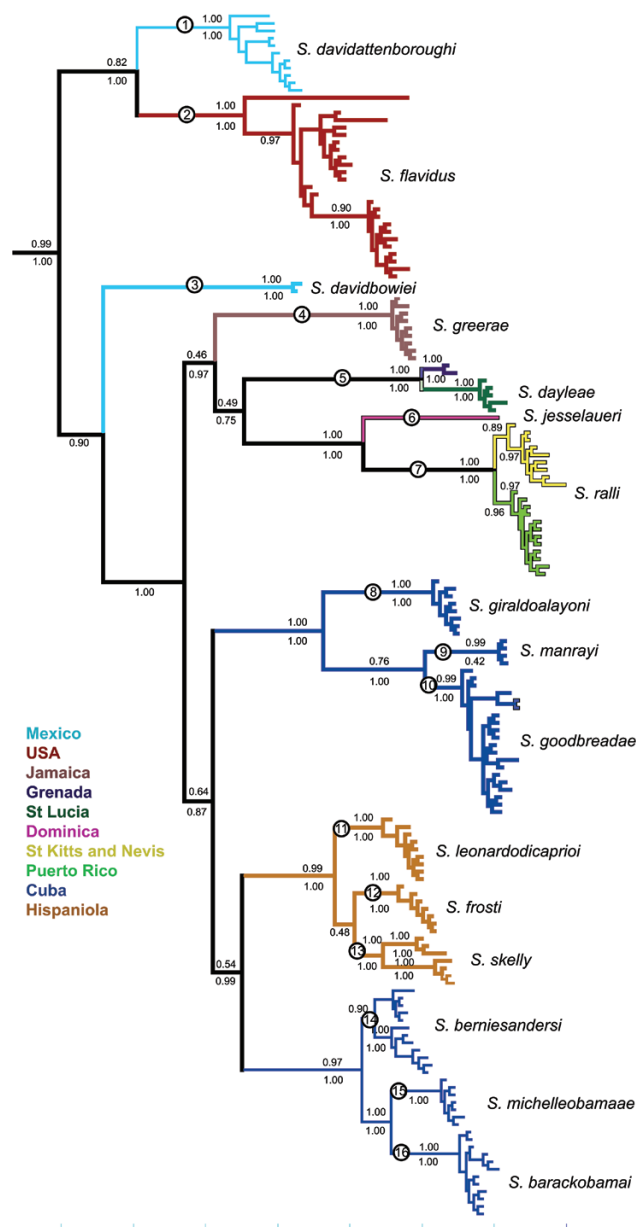
while *Spintharus dayleae* sp. nov. has distinct populations on Grenada and St. Lucia. The only islands that share haplotypes are *S. ralli* sp. nov. specimens from St. Kitts and Nevis, small keys separated by less than 30 km of shallow ocean. The genetically distinct sister clade to the St. Kitts and Nevis clade is, in contrast, Puerto Rico separated by over 250 km. The largest Greater Antilles islands, Cuba and

Hispaniola, harbour within-island radiations resulting in multiple species-level clades.

#### BIOGEOGRAPHICAL PATTERNS

Details of biogeography of Caribbean *Spintharus* are discussed in Dziki *et al.* (2015). The findings support a single colonization of the Caribbean about 32





**Figure 3.** Phylogeny of *Spintharus* spiders here revised, reproduced from Dziki *et al.* (2015). Clades are coloured according to the country of origin, as in legend. Numbers above branches are maximum likelihood bootstraps, and numbers below branches are Bayesian posterior probabilities. Clades delimited as species by our analyses are highlighted with a number on the branch from species 1 to 16.

Mya that aligns with the timing of the GAARlandia land bridge. We see two major lineages within the Caribbean, one comprised Cuba and Hispaniola and the other made up of Jamaican, Puerto Rican and Lesser Antillean endemics. The ages and relatedness of these clades align with the geological history of the Caribbean Islands (Dziki *et al.*, 2015) with the notable exception of Puerto Rican taxa being young and closely related to the Lesser Antillean clades. This suggests that Puerto Rico was only colonized

relatively recently, perhaps via overwater dispersal from the Lesser Antilles.

## DISCUSSION

The Caribbean archipelago is a biodiversity hotspot, yet some of its megadiverse lineages, such as many invertebrates, are taxonomically poorly known. In many cases, taxonomy lags far behind phylogeny, which hinders the application of knowledge to conservation biology and

evolutionary and biodiversity research. Recently, [Dziki et al. \(2015\)](#) conducted phylogenetic and biogeographical analyses of the putatively widespread cobweb spider *S. flavidus*. They instead concluded that ‘*Spintharus flavidus*’ is an ancient lineage, probably colonized the Caribbean about 32 Mya over the GAARlandia land bridge, and is composed of multiple short-range endemics. Our goal here is to bring the taxonomy of Caribbean *Spintharus* up to date with current phylogenetic knowledge, without a major time lag. Our analyses – based on [Dziki et al. \(2015\)](#) data set and phylogenetic results – confirm the presence of 16 species, all of which are here described, thereof 15 new species. These species are nearly all short-range endemics, whether on the mainland or islands, and most are restricted to single islands. This transformation of knowledge where a putatively widespread and common species is found instead to be a complex of short-range endemics, not only dramatically impacts our estimates of biodiversity, but has obvious implications for the field of conservation biology. Each *Spintharus* species now requires evaluation of its conservation status. As charismatic ‘smiley-faced’ spiders, *Spintharus* also lend themselves to public conservation outreach, as have the Hawaiian happy-faced spiders (*T. grallator*) of the same family (e.g. [Croucher et al., 2012, 2013](#)). Local endemics carry their own unique ‘smile’ (Fig. 1A) and will no doubt be a source of local pride of endemic biodiversity.

Furthermore, our research uncovers a potential treasure trove for evolutionary studies. For example, studies of allopatric speciation and how it may relate to colour polymorphism and the potential adaptive radiation of different colour forms of these ornate spiders on different islands ([Gillespie, 1989](#); [Oxford & Gillespie, 1996](#); [Gillespie & Oxford, 1998](#); [Croucher et al., 2012, 2013](#)). In sum, when taxonomy keeps pace with phylogeny, the potential of lineages to contribute to biodiversity research, evolutionary studies and conservation biology is maximized.

## TAXONOMY

### THERIDIIDAE SUNDEVALL, 1833

See [Agnarsson & Levi \(2017\)](#) for diagnosis and [World Spider Catalog \(2017\)](#) for content.

### SPINTHARINAE SIMON, 1894

See [Agnarsson \(2004\)](#) and [Agnarsson & Levi \(2017\)](#) for diagnosis and contents.

### SPINTHARUS HENTZ, 1850

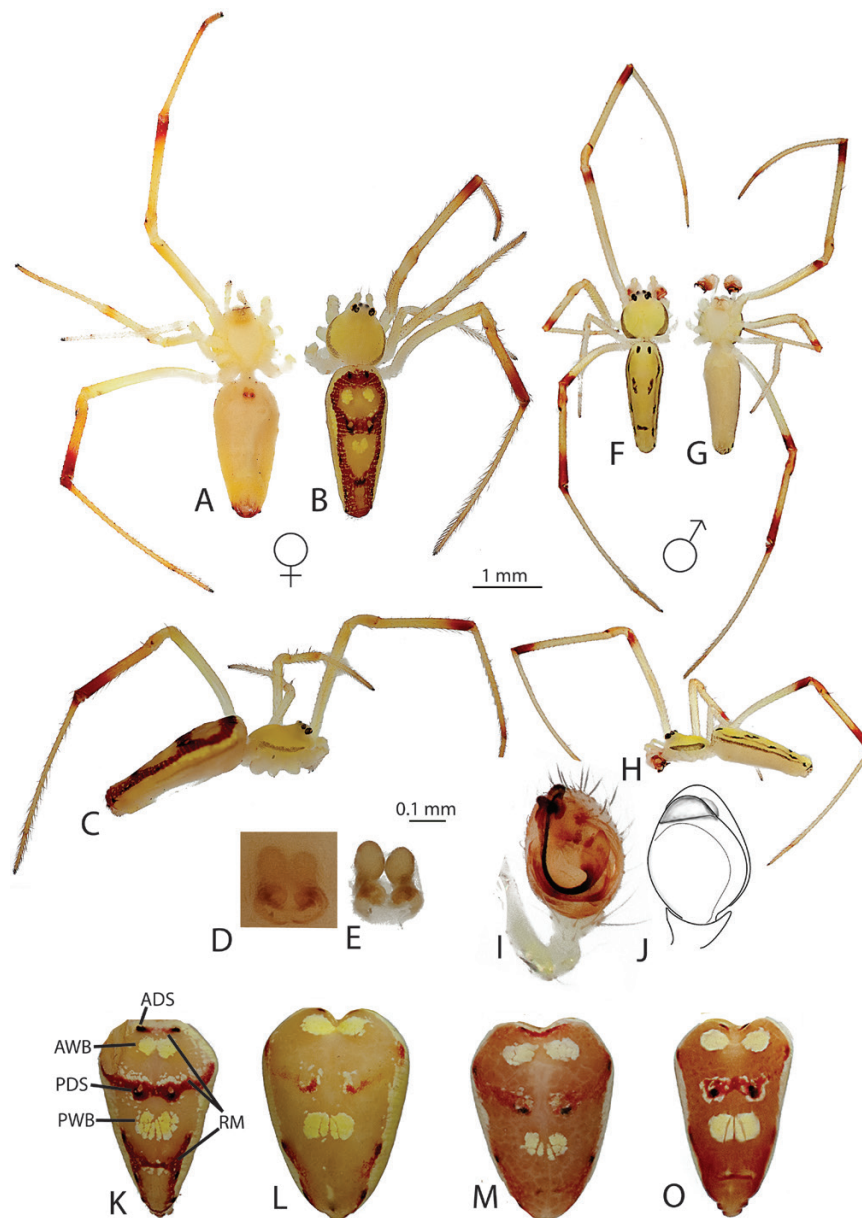
As other theridiids, ecribellate araneoids with three tarsal claws and few or no leg spines, lacking rebordered labium, and bearing a distinct comb of setae

on the fourth tarsus that is most robust in females. Carapace and abdomen pale to bright yellow. Carapace low and nearly circular. Female abdomen variable in shape, elongated to kite-like shaped, sometimes with humps, decorated with a number of small black and four larger white dots, often surrounded by red markings in the female. Dark or white stripe typically separating the uniformly coloured venter from the ornate dorsum. Colulus small bearing two setae. Male epigynous glands may be absent ([Agnarsson, 2004](#): fig. 69F). Eight eyes, with lateral eyes juxtaposed, however, eye size and placement somewhat variable. Eyes typically surrounded by black markings. Chelicerae small and slender, with a single tooth, or a tooth-like process ([Agnarsson, 2004](#): fig. 70E, F). Legs long and thin, with leg formula 4123 and leg IV only slightly longer than leg I. Usually four small trichobothria dorsally on tibia I, four on tibia II. Trichobothria on all metatarsi (1–2), 4–5 dorsal trichobothria on female palpal tibia. Male palp with an embolus forming a single wide spiral, a large conductor and bearing a paracymbial hood (Fig. 4J; [Agnarsson, 2004](#): 468). Epigynum a small pit with copulatory openings separated by more than their diameter. Spermathecae clearly visible through the cuticle. Web simple H shaped (Fig. 1A), with sticky globules near substrate ([Eberhard et al., 2008](#)). See [Hentz \(1850\)](#), [Levi \(1954a, 1963a\)](#) and [Durán-Barrón et al. \(2013\)](#) for additional descriptions and diagnoses.

*Note on diagnoses:* We are faced with the same problems observed by [Levi \(1954a, 1963a\)](#) observing high variability in habitus coloration within and across species, and relatively simple and variable genitalia (Fig. 2I–K), that offer limited information for clear diagnoses. There is no doubt that Herbert Levi was the greatest theridiid taxonomist the field has seen, and his inability to detect geographically structured diagnostic variation within this complex is revealing. Thus, our diagnoses rely primarily on molecular data. We describe, under ‘diagnosis’ morphological traits that may be of some aid in the morphological identification of the species including female abdomen shape and colour pattern, and male palpal embolus shape and angle. However, in most cases, such ‘diagnoses’ are vague at best and will probably be even less useful when more variation is revealed through further specimens and when further new species will be described.

*Description of colour patterns and abbreviations:* We attempt to describe female abdominal shape and colour patterns focusing on the four white blotches, four posterior-most dark spots and extent of red colour markings of the abdomen. Blotches and spots will be abbreviated as follows: anterior white blotches (AWB), posterior white blotches (PWB), dark spots (DS), anterior dark spots (ADS), posterior dark spots (PDS), red markings will be abbreviated (RM), see [Figure 4K](#) for clarification.





**Figure 4.** *Spintharus flavidus* Hentz 1850. A–E, female. A–C, habitus: A, ventral; B, dorsal; C, lateral. D–E, epigynum: D, ventral; E, digested dorsal. F–J, male. F–H, habitus: F, dorsal; G, ventral; H, lateral. I–J, palp. I, ventral; J, drawing of cymbial hood. K–O, variation in female abdomen across the range of CarBio samples. K, the features of the abdomen used to aid species diagnoses; anterior (AWB) and posterior (PWB) white blotches; anterior (ADS) and posterior (PDS) dark spots; and red markings (RM).

*SPINTHARUS FLAVIDUS* HENTZ, 1850

FIGS 1A, B, 2A–H, J, K, 4A–M

#### Type material

Female holotypes and paratypes from **USA**, Alabama, lost (Levi, 1963a).

Additional specimens from **USA**: South Carolina, Francis Marion National Forest, Buck Hall Camp ground, 33.0391N 79.5645W, 7 m, team CarBio; North

Carolina, Cherokee National Forest, 36.0561 82.7085W, 840 m, 31.v.2013, team CarBio; Florida, Boulware Springs, 29.6195N 82.3066W, 26 m, 11.vi.2013, team CarBio; Florida, Mahogany Hammock, 0 m, 28.3238N 80.8319W, 06–07.vi.2013, team CarBio; 1.vi.2013, team CarBio; Florida, Mill Creek Preserve, 29.6269N 82.2988W, 35 m, 11.vi.2013, team CarBio; Florida, Alexander Springs, 33.0391N, 79.5646W, 7 m, 3.vi.2013, team CarBio.

### Taxonomic note

Current synonyms (information from [Levi, 1963a](#)): *Spintharus elongatus* Keyserling, 1884, Die Spinnen Amerikas, Theridiidae, 1: 178, pl. 8, fig. 108. Female type from Peru in the Polish Academy of Sciences, Warsaw (not examined); *Spintharus lineatus* O. P.-Cambridge, 1896, Biologia Centrali-Americana, Araneidea, 1: 190, pl. 23, fig. 11, 6. Male holotype from Guatemala in the British Museum (not examined); *Spintharus affinis* O. P.-Cambridge, 1896, op. cit. 1: 190, pl. 24, figs 2, 6. Male holotype from Guatemala in the British Museum (not examined).

[Hentz \(1850: 284\)](#) described the type specimen ‘Yellowish; abdomen orange yellow, edge white, disk with a yellow margin, and spots surrounded and crossed in two places by a scarlet line, orange yellow, spotless beneath; feet, first and fourth pair with the antepenult joint tipped with orange...’. [Levi \(1954a, 1963a\)](#) offers further descriptions and illustrations from across the *Spintharus* range. He observed a specimen from Alabama ([Levi, 1954a: 81](#)): ‘A specimen from Alabama measured 3.60 total length; carapace 1.10 long, 1.07 wide, 0.44 high. First femur, 2.20; patella and tibia, 2.14; metatarsus, 2.31; tarsus, 0.56. Second patella and tibia, 1.17. Third patella and tibia, 0.75. Fourth femur, 2.45; patella and tibia, 2.20; metatarsus, 2.70; tarsus, 0.69’.

### Diagnosis

Female abdomen elongate to oval without humps ([Fig. 4A, B, K–O](#)), AWB juxtaposed or slightly separate, PWB juxtaposed or fused. ADS separated by more than their diameter, sometimes indistinct, PDS further apart than ADS. RM extensive covering DSs and surrounding WBs, extending to abdomen tip, sometimes continuous. Embolus base narrow, with robust and tightly curving spiral terminating at about approximately in palpal plane ([Fig. 4I](#)).

*Spintharus flavidus* can be diagnosed from most other *Spintharus* here treated based on the following partially shared nucleotide substitutions, and all other species by their unique combination: G (28, except *Spintharus greerae*), A (202, except *Spintharus jesselaui*), A (205, except *S. greerae*), A (206, except *S. greerae*), A (482, except *S. greerae*), A (484, except some *Spintharus skelly*).

### Redescription

*Female (from Florida, Brevard Co., 28.3238 N 80.8319 W)*: Total length 3.31. Cephalothorax 1.15 long, 1.03 wide, 0.63 high. Sternum 0.72 long, 0.62 wide, extending half way between coxae IV, pale yellow. Abdomen 2.29 long, 1.11 wide, 0.78 high. Yellow base, yellow border red centre, with small black dots and

two large yellow patches. Eyes approximately equal in size Anterior Median Eyes (ALE) 0.07, Anterior Lateral Eyes (AME) 0.07 in diameter. All eyes within one eye diameter apart from each other excluding the posterior median, which are about two eye diameters apart at 0.14. Chelicerae with one large tooth. Leg I femur 2.21, patella 0.40, tibia 1.12, metatarsus 2.29, tarsus 0.72. Legs II and III yellow, legs I and IV yellow with red at junctions between tibia and metatarsus.

*Male (from Florida, Brevard Co., 28.3238 N 80.8319 W)*: Total length 2.46. Cephalothorax 0.75 long, 0.79 wide, high 0.44. Sternum 0.53 long, 0.52 wide, extending half way between coxae IV, pale yellow. Abdomen 1.70 long, 0.60 wide, 0.51 high. Yellow base, black border, with small black dots, six black dots in centre abdomen. Eyes approximately equal in size ALE 0.08, AME 0.08 in diameter. All eyes within one eye diameter apart from each other excluding the posterior median, which are approximately two eye diameters apart at 0.17. Chelicerae with one large tooth. Leg I femur 2.21, patella 0.40, tibia 1.70, metatarsus 1.89, tarsus 0.23. Leg IV slightly longer than leg 1. Legs II and III yellow, legs I and IV yellow with red at junctions between patella and tibia and the tibia and metatarsus.

*Variation*: Female total length 3.48–4.62, cephalothorax 0.91–1.14, femur I 1.15–2.08; male total length 2.46–3.94, cephalothorax 0.75–1.42, femur I 2.21–3.24.

### Note

The types of *S. flavidus* from Alabama are lost. Given that our samples from the USA include specimens from the nearby state of Florida, and our (conservative) species delimitation methods suggest only a single US species in our sample, we describe these samples as tentatively belonging to *S. flavidus*. However, there is deep genetic structure among the US specimens ([Fig. 3](#)) and [Levi \(1963a: plate 24\)](#) observed profuse variation in male palps across the USA ([Fig. 2](#)). Thus, future DNA sampling of *Spintharus* from the type locality and thorough sampling of North American *Spintharus* will be needed to test the species limits of USA *S. flavidus*. Types of current synonyms are from Central and South America. Given observed short-range endemism, and geographic distances between our closest samples from Mexico to the two available names from Guatemala, we predict that none of our 15 new species are conspecific with the available names *Spintharus elongatus*, *S. lineatus* and *S. affinis*. Further support for that hypothesis comes from Levi’s examination of these types and his illustrations, and his summary of striking variation in male palps over short geographical distances in Central America. However, further DNA evidence from dense

sampling of Central and South American *Spintharus* will be necessary to fully clarify the taxonomy of the genus and the status of the currently available names with respect to those newly described here. This, however, is an enormous task given the wide distribution of the genus and patterns of narrow endemism.

***SPINTHARUS DAVIDATTENBOROUGHII* AGNARSSON & VAN PATTEN SP. NOV.**

FIG. 5A–M

*Type material*

Holotype male from **Jamaica**, Cockpit Country, outside Harvey cave, 18.3040N 77.5711W, 509 m, 13.xi.2013, team CarBio, in NMNH.

Additional specimens from **Jamaica**: Cockpit Country, trail to upper Windsor Cave 18.3388N 77.6111W, 277 m, 11.xi.2013, team CarBio; Cockpit Country, Oatley Mountain trail, 18.0890N 76.7276W, 1323 m, team CarBio; Blue Mountains, Ranger Station, 18.0535N, 076.5995W, 1671 m, 14.xi.2013, team CarBio.

*Etymology*

The species epithet honours Sir David Attenborough for his extraordinary effort to enlighten the public about the wonders of the natural world, to make humanity care about nature, and for inspiring countless people to pursue the study of biology, the current authors included.

*Diagnosis*

Female abdomen subtriangular to oval without humps (Fig. 5A–G). AWB juxtaposed or slightly separate, PWB fused. ADS separated by less than their diameter, sometimes indistinct, PDS separated by their diameter or less, indistinct. RM dusky grey with only faint red streaks or no red, covering DSs and surrounding AWB and sometimes PWB and then extending to abdomen tip, sometimes continuous. Embolus base narrow, with robust and relatively gradually curving spiral terminating at about approximately in palpal plane (Fig. 5L–M).

*Spintharus davidattenboroughi* can be diagnosed from other *Spintharus* here treated based on the following unique mtDNA nucleotide substitutions at the following standard DNA barcode alignment positions: C (578), C (598). It can also be readily diagnosed from most other *Spintharus* based on the following partially shared nucleotide substitutions, and all other species by their unique combination: G (43, except some *S. greerae*), C (74, except *Spintharus davidbowiei*), G (280, except some *S. ralli*), G (283, except *S. ralli*), C (514, except some *S. dayleae*), A (568, except some *S. flavidus*).

*Description*

**Female:** Total length 3.68. Cephalothorax 1.10 long, 0.99 wide, high 0.63. Sternum 0.55 long, 0.55 wide, extending half way between coxae IV, pale yellow. Abdomen 2.96 long, 2.02 wide, 1.64 high. Eyes approximately equal in size ALE 0.16, AME 0.14 in diameter. All eyes within one eye diameter apart from each other excluding the posterior median, which are approximately one eye diameters apart at 0.34. Leg I femur 2.48, patella 0.35, tibia 1.56, metatarsus 2.18, tarsus 0.59. Leg IV slightly longer than leg 1. Legs II and III yellow, legs I and IV yellow with red at junctions between patella and tibia and the tibia and metatarsus.

**Male:** Total length 2.61. Cephalothorax 1.24 long, 0.76 wide, high 0.46, pale yellow with black lateral stripe. Sternum 0.59 long, 0.42 wide, extending half way between coxae IV, pale yellow. Abdomen 1.85 long, 0.69 wide, 0.64 high. Yellow base, black border with six black dots along the border. Eyes approximately equal in size ALE 0.08, AME 0.08 in diameter. All eyes within one eye diameter apart from each other excluding the posterior median, which are 0.14 apart. Chelicerae with one large tooth. Leg I femur 1.68, patella 0.30, tibia 1.35, metatarsus 1.93, tarsus 0.38. Leg formula 3214 with leg VI slightly longer than leg I. Legs II and III pale yellow. Legs I and IV pale yellow with a dark red patch where the femur meets the patella and where the tibia meets the metatarsus.

**Variation:** Female total length 2.27–3.68, cephalothorax 0.62–1.10, femur 1 1.31–2.48; male total length 2.60–2.61, cephalothorax 0.71–1.24, femur I 1.30–1.68.

***SPINTHARUS BARACKOBAMAI* AGNARSSON & VAN PATTEN SP. NOV.**

FIG. 6A–H

*Type material*

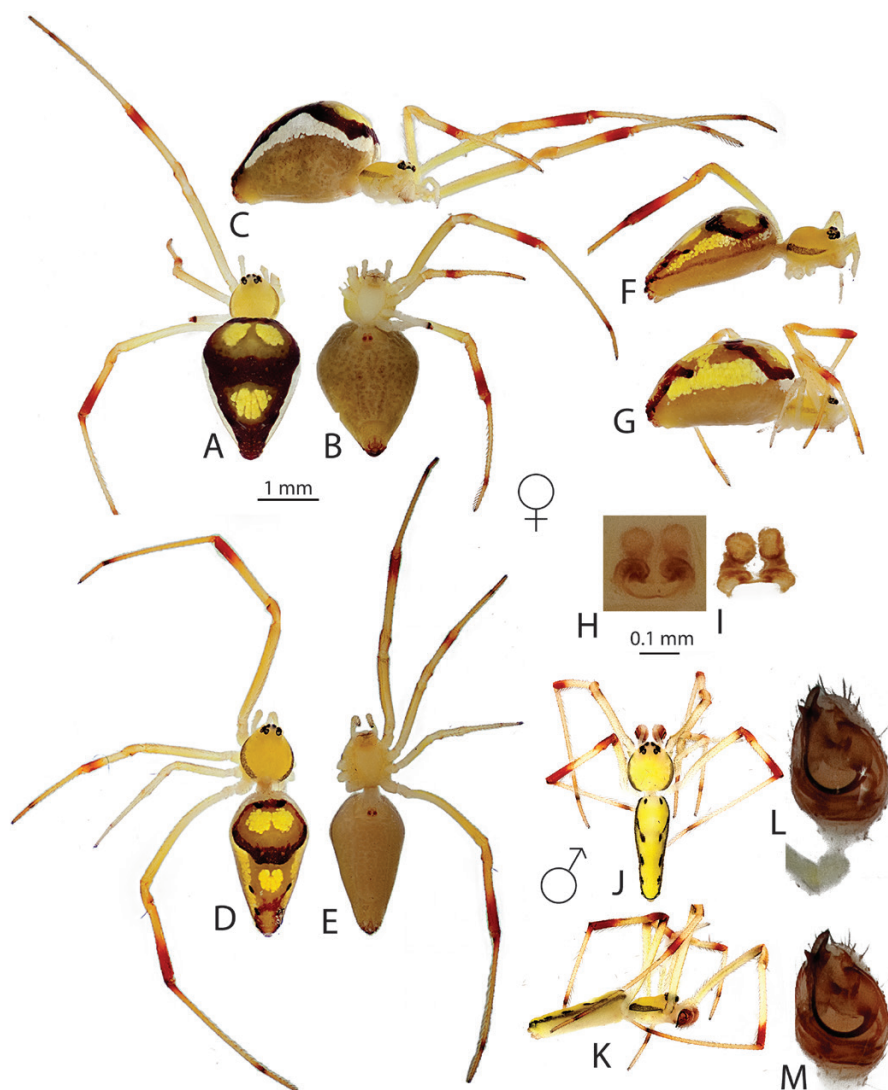
Holotype female from **Cuba**, Camagüey, Sierra de Cubitas, 21.59166N 77.78822W, 100 m, 11–13.iv.2012, team CarBio, in NMNH.

Additional specimens from same locality and from **Cuba**, Viñales, Viñales National Park, Pinar del Rio, Sierra de los Viñales, 22.65707N 83.70161W, 280 m, 20–21.iv.2012, team CarBio.

*Etymology*

The species epithet honours former US president Barack Obama for the dignity, humanitarianism, statesmanship and respect he brought to the oval office; a true world leader.





**Figure 5.** *Spintharus davidattenboroughi* Agnarsson & Van Patten **sp. nov.** A–I, female. A–G, habitus: A, dorsal; B, ventral; C, lateral. D–G, images of other females showing variation. D, dorsal; E, ventral; F–G, lateral. H–I, epigynum: H, ventral; I, digested dorsal. J–M, male. J–K, habitus: J, dorsal; K, lateral; L–M, palp ventral, showing two specimens.

### Diagnosis

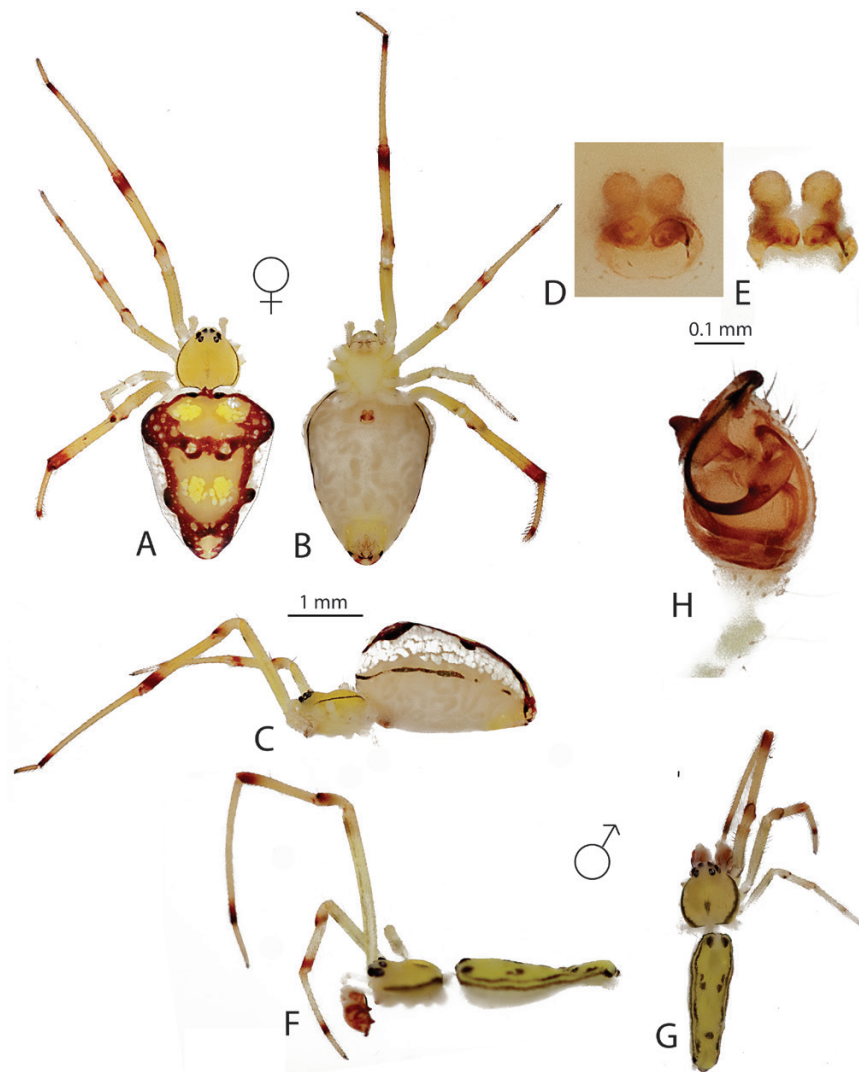
Female abdomen subtriangular without humps (Fig. 6A–C). AWB separate, PWB juxtaposed. ADS separated by more than their diameter, PDS about the same distance apart as ADS. RM bright, extensive and continuous, covering DSs and surrounding WBs, extending to abdomen tip. White markings unusually broad and clearly visible dorsally. Embolus base narrow, with robust and relatively gradually curving spiral terminating at about 40° angle (Fig. 6H).

*Spintharus barackobamai* can be diagnosed from other *Spintharus* here treated based on the following unique mtDNA nucleotide substitutions at the following standard DNA barcode alignment positions: C (163), C (356). It can also be readily diagnosed from

most other *Spintharus* based on the following partially shared nucleotide substitutions, and all other species by their unique combination: T (83, except *S. greerae* and *S. flavidus*), C (263, except *S. davidbowiei*).

### Description

**Female:** Total length 3.44. Cephalothorax 1.01 long, 0.98 wide, 0.67 high, pale yellow with faint brown lateral stripe. Sternum 0.69 long, 0.57 wide, extending half way between coxae IV, pale yellow. Abdomen 2.75 long, 2.01 wide, 1.59 high. Eyes approximately equal in size 0.07 in diameter. All eyes within one eye diameter apart from each other excluding the posterior median, which are ~2 AME diameters. Leg I femur 1.54, patella



**Figure 6.** *Spintharus barackobamai* Agnarsson & Van Patten **sp. nov.** A–E, female. A–C, habitus: A, ventral; B, dorsal; C, lateral. D–E, epigynum: D, ventral; E, digested ventral. F–H, male. F–G, habitus: F, dorsal; G, lateral. I, palp ventral.

0.39, tibia 1.31, metatarsus 1.99, tarsus 0.38. Leg IV slightly longer than leg I. Legs II and III pale yellow. Legs I and IV yellow with red at junctions between tibia and metatarsus.

**Male:** Total length 2.88. Cephalothorax 0.87 long, 0.81 wide, high 0.68. Sternum 0.69 long, 0.60 wide, extending half way between coxae IV, pale yellow. Abdomen 1.99 long, 0.66 wide, 0.69 high. Eyes approximately equal in size ALE 0.06, AME 0.10 in diameter. All eyes within one eye diameter apart from each other excluding the posterior median, which are 0.14 apart. Chelicerae with one large tooth. Leg I femur 2.44, patella 0.49, tibia 1.52, metatarsus 1.20, tarsus 0.44. Leg III pale yellow. Legs I and II with dark red patch where the tibia meets the metatarsus and where the tarsus meets the metatarsus. Leg I also has a dark red patella.

**Variation:** Female total length 2.98–3.44, cephalothorax 0.93–1.01, femur I 1.54–1.81. Male cephalothorax 0.82–0.87, femur I 1.88–2.00. No additional intact males available for total length estimates.

***SPINTHARUS MICHELLEOBAMAE* AGNARSSON & SARGEANT **SP. NOV.****

**FIG. 7A–I**

**Type material**

Holotype female from **Cuba**, Granma, Turquino National Park, Aguada de Joaquin, 20.01303N, 76.86833W, 1634 m, 3.v.2013, Franklyn Riquelme, in NMNH.

Additional specimens from **Cuba**, Granma, Turquino National Park, Bartolomé Masso, 20.01309N 76.83400W, 1154 m, 24–25.iii.2012, team CarBio.

### Etymology

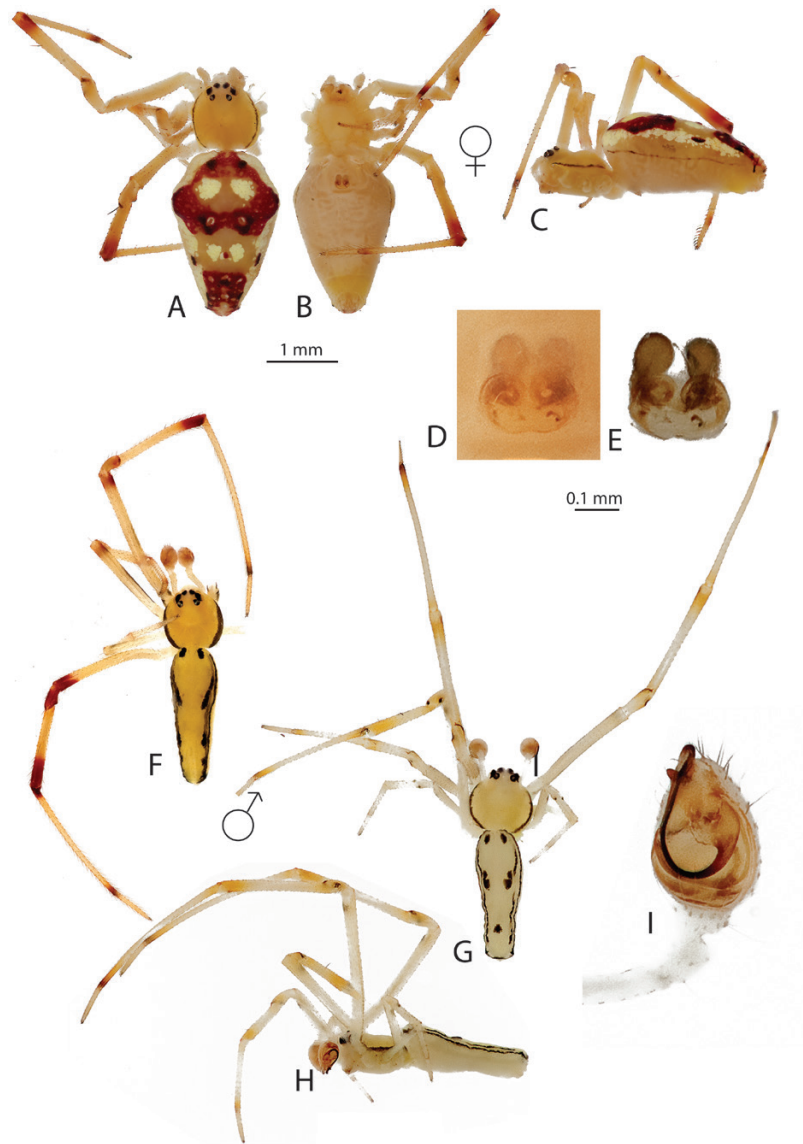
The species epithet honours former first lady Michelle Obama who has long fought to defend human rights, fairness, and equality for all, with her characteristic dignity and grace.

### Diagnosis

Female abdomen subtriangular but with widest point relatively far from abdomen anterior, without humps (Fig. 7A–C). AWB positioned relatively posteriorly, separate, PWB separate. ADS separated by 2–3× their diameter, PDS about the same distance apart as ADS.

RM bright, extensive, though discontinuous, covering DSs and surrounding AWB, extending to abdomen tip. White markings unusually broad and clearly visible dorsally. Embolus base broad, with relatively slender and gradually curving spiral terminating at a very slight angle (Fig. 6I).

*Spintharus michelleobamae* can be diagnosed from other *Spintharus* here treated based on the following unique mtDNA nucleotide substitutions at the following standard DNA barcode alignment positions: C (133), C (206), C (220). It can also be readily diagnosed from most other *Spintharus* based on the following partially shared nucleotide substitutions, and



**Figure 7.** *Spintharus michelleobamae* Agnarsson & Sargeant **sp. nov.** A–E, female. A–C, habitus: A, ventral; B, dorsal; C, lateral. D–E, epigynum: D, ventral; E, digested dorsal. F–I, male. F–H, habitus: F, dorsal; G, dorsal male 2; H, lateral. I, palp ventral.



all other species by their unique combination: C (115, except *S. davidbowiei*), G (649, except some *S. greerae*).

### Description

**Female:** Total length 3.37. Cephalothorax 0.96 long, 1.01 wide, 0.68 high, pale yellow with faint black lateral stripe. Sternum 0.80 long, 0.55 wide, extending half way between coxae IV, pale yellow. Abdomen 2.40 long, 1.58 wide, 1.19 high. Eyes approximately equal in size ALE 0.09, AME 0.08 in diameter. All eyes within one eye diameter apart from each other excluding the posterior median, which are 0.17 apart, ~2 AME diameters apart. The posterior median eyes are notably smaller than the other eyes at 0.07 in diameter. Leg I missing half way into the femur. Leg IV slightly longer than leg 1. Legs II and III pale yellow. Legs I and IV yellow with red at junctions between tibia and metatarsus, and the tarsus and the metatarsus.

**Male:** Total length 2.84. Cephalothorax 0.98 long, 0.99 wide, 0.56 high, pale yellow with black lateral stripe. Sternum 0.67 long, 0.50 wide, extending half way between coxae IV, pale yellow. Abdomen 1.93 long, 0.69 wide, 0.69 high. Eyes slightly raised from cephalothorax, approximately equal in size ALE 0.09, AME 0.12 in diameter. All eyes within one eye diameter apart from each other excluding the posterior median, which are 0.15 apart about one and one-half eye widths apart. Leg I femur 2.21, patella 0.46, tibia 1.44, metatarsus 2.28, tarsus 0.66. Legs II–IV pale yellow. Leg I slight darkening where the tarsus meets the metatarsus.

**Variation:** Only one adult female, male total length 2.67–2.14, cephalothorax 0.68–0.80, femur I 1.92–1.42.

### *SPINTHARUS BERNIESANDERSI* AGNARSSON & SARGEANT **SP. NOV.**

FIG. 8A–K

#### Type material

Holotype female from **Cuba**, Holguin, Mayari National Park ‘Mensura-Piloto’, 20.52917N 75.76820W, 747 m, 10.v.2013, Franklyn Riquelme, in NMNH.

Additional specimens from **Cuba**, Guantanamo, Baracoa, El Yunque, 20.34501N 74.56642W, 370 m, 05.iv.2012, team CarBio; Santiago de Cuba, Gran Piedra, Siera Mae, 20.0117N 75.3848W, 1130 m, 3.iv.2012, team CarBio.

#### Etymology

The species epithet honours the great Vermont senator Bernie Sanders, a tireless fighter for human rights and equality, and environmentally aware social democracy.

### Diagnosis

Female abdomen nearly oval, without humps (Fig. 8A–C). AWB positioned relatively posteriorly, separate, PWB fused. ADS separated by about their diameter, PDS about the same distance apart as ADS. RM dark patchy, covering DSs but not fully surrounding WBs, extending to abdomen tip. Embolus base narrow, with relatively slender and gradually curving spiral terminating at a very slight angle (Fig. 8K).

*Spintharus berniesandersi* can be diagnosed from other *Spintharus* here treated based on the following unique mtDNA nucleotide substitutions at the following standard DNA barcode alignment positions: G (97), C (190), C (439), C (613).

### Description

**Female:** Total length 2.89. Cephalothorax 0.91 long, 0.93 wide, 0.65 high, yellow-brown with defined black stripe along carapace outline. Sternum 0.67 long, 0.54 wide, extending half way between coxae IV, yellow-brown. Abdomen 2.17 long, 1.13 wide, 0.95 high. Eyes approximately equal in size ALE 0.08, AME 0.07 in diameter. All eyes within one eye diameter apart from each other, except the posterior median, which are ~0.16 apart. Leg I femur 1.74, patella 0.46, tibia 1.32, metatarsus 1.84, tarsus 0.50. Leg I and Leg II have red on the patella where it meets the tibia and red on the tibia where it meets the metatarsus. Red on the metatarsus where it meets the tarsus on legs I and II.

**Male:** Total length 2.66. Cephalothorax 0.98 long, 0.79 wide, 0.51 high, pale yellow with black lateral stripe. Sternum 0.59 long, 0.48 wide, extending half way between coxae IV, pale yellow. Abdomen 1.77 long, 0.54 wide, 0.64 high. The eyes are slightly raised from the cephalothorax. Eyes approximately equal in size ALE 0.08, AME 0.09 in diameter. All eyes within one eye diameter apart from each other excluding the posterior median, which are 0.11 apart. Leg IV femur 1.83, patella 0.46, tibia 1.56, metatarsus 1.79, tarsus 0.54. Legs II and III pale yellow. Leg VI with red patch where the tibia meets the metatarsus and the same red colour is also noted on the patella.

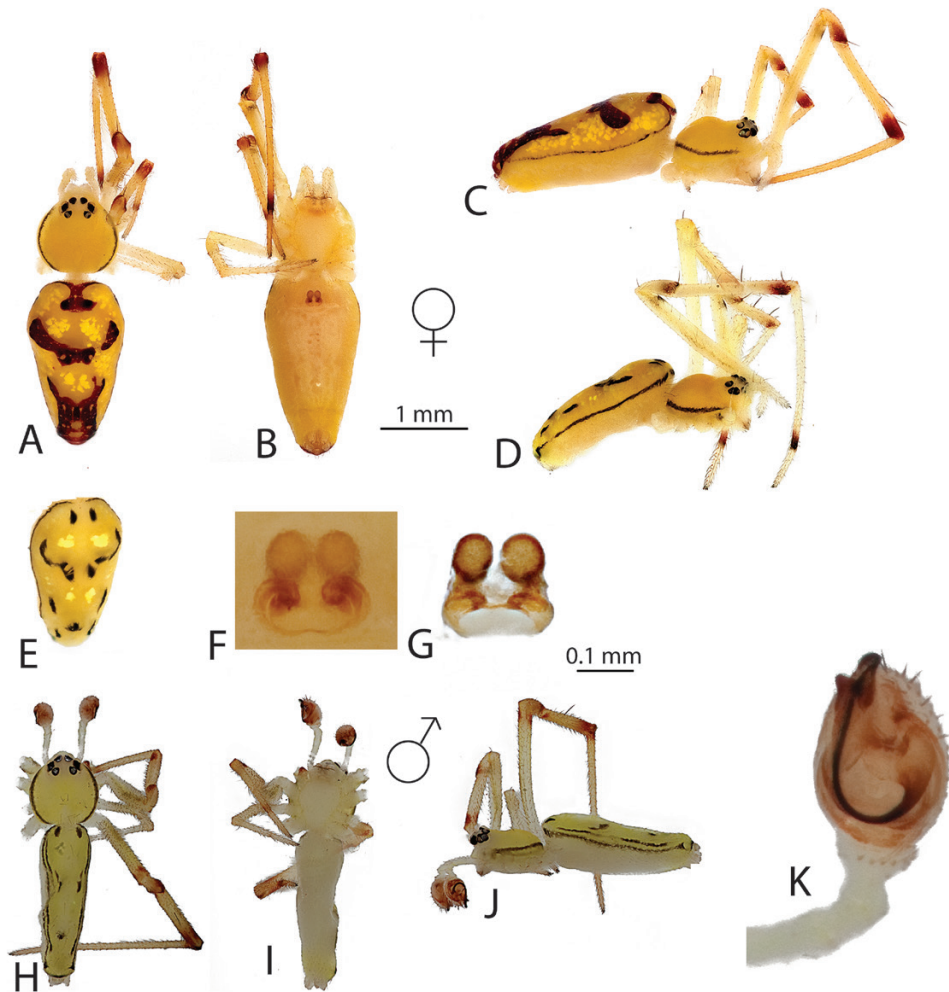
**Variation:** Female total length 2.89–2.40, cephalothorax 0.91–0.80, femur I 1.75–1.44. Male total length 2.47–2.66, cephalothorax 0.74–0.98, femur I 1.23–1.90.

### *SPINTHARUS LEONARDODICAPRIOI* VAN PATTEN & AGNARSSON **SP. NOV.**

FIG. 9A–I

#### Type material

Holotype female from **Dominican Republic**, La Alta Gracia, Occidental, San Rafael de Yuma, Loma Quita



**Figure 8.** *Spintharus berniesandersi* Agnarsson & Sargeant **sp. nov.** A–G, female. A–D, habitus: A, ventral; B, dorsal; C, lateral; D, juvenile lateral; E, juvenile dorsal abdomen. F–G, epigynum: F, ventral; G, digested dorsal. H–K, male. H–J, habitus: H, dorsal; I, ventral; J, lateral. K, palp ventral.

Espuela, 19.35504N 070.1110W, 200 m, 14.vi.2012, team CarBio, in NMNH.

Additional specimens from same locality.

### Etymology

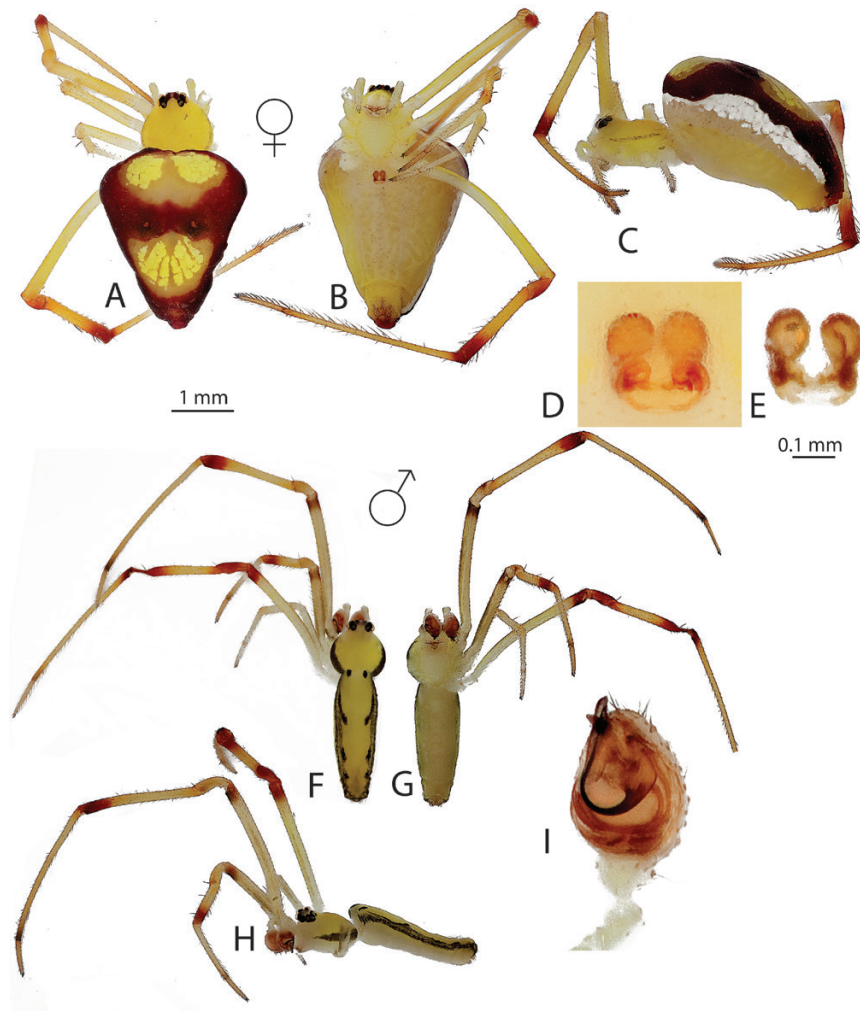
The species epithet honours the talented actor Leonardo DiCaprio for his amazing acting, and, in particular, for his leading role in bringing awareness of the perils of global climate change to the public and politicians alike.

### Diagnosis

Female abdomen subtriangular, without humps (Fig. 9A–C). AWB, separate, PWB fused. ADS separated by more than their diameter, PDS about the

same distance apart as ADS. RM extensive and continuous, covering DSs and surrounding WBs, extending to abdomen tip. Embolus relatively small, base broad, with relatively short gradually curving spiral terminating at a very slight angle (Fig. 9I).

*Spintharus leonardodicaprio* can be diagnosed from other *Spintharus* here treated based on the following unique mtDNA nucleotide substitutions at the following standard DNA barcode alignment positions: A (122), C (355), T (470). It can also be readily diagnosed from most other *Spintharus* based on the following partially shared nucleotide substitutions, and all other species by their unique combination: G (520, except *S. frosti*), C (601, except some *S. skelly*).



**Figure 9.** *Spintharus leonardodicaprioi* Van Patten & Agnarsson **sp. nov.** A–E, female. A–C, habitus: A, ventral; B, dorsal; C, lateral. D–E, epigynum: D, ventral; E, digested dorsal. F–I, male. F–H, habitus: F, dorsal; G, ventral; H, lateral. I, palp ventral.

### Description

**Female:** Total length 3.88. Cephalothorax 1.25 long, 1.19 wide, 0.66 high, pale yellow with faint brown lateral stripe. Sternum 0.70 long, 0.61 wide, extending half way between coxae IV, pale yellow. Abdomen 3.03 long, 2.40 wide, 1.26 high. Eyes approximately equal in size ALE 0.10, AME 0.09 in diameter. All eyes within one eye diameter apart from each other excluding the posterior median, which are 0.19 apart. Chelicerae with one large tooth. Leg I femur 2.20, patella 0.42, tibia 1.53, metatarsus 2.27, tarsus 0.61. Leg IV slightly longer than leg I. Legs II and III pale yellow. Legs I and IV yellow with red at junctions between patella and tibia and the tibia and metatarsus.

**Male:** Total length 2.85. Cephalothorax 0.99 long, 0.88 wide, 0.65 high, pale yellow with black lateral

stripe. Sternum 0.58 long, 0.53 wide, extending half way between coxae IV, pale yellow. Abdomen 2.08 long, 0.70 wide, 0.58 high. Eyes approximately equal in size ALE 0.10, AME 0.10 in diameter. All eyes within one eye diameter apart from each other excluding the posterior median, which are 0.13 apart. Leg I femur 2.05, patella 0.49, tibia 1.36, metatarsus 2.31, tarsus 0.67. Leg IV slightly longer than leg I. Legs III pale yellow. Legs I and II with red patch where the tibia meets the metatarsus. Leg IV with red patch where the tibia meets the metatarsus as well as a dark red patella.

**Variation:** Female total length 3.36–4.08, cephalothorax 1.03–1.20, femur I 2.07–2.38. Male total length 2.81–2.85, cephalothorax 0.90–0.99, femur I 2.05–2.20.



*SPINTHARUS DAVIDBOWIEI* AGNARSSON & CHOMITZ SP. NOV.

FIG. 10A–E

*Type material*

Holotype male from **Mexico**, Yucatan Peninsula, Quintana Roo, outside Cueva Mil Columnas, 20.33378N 87.3886W, 11 m, 31.vii.2014, team CarBio, in NMNH.

Juvenile female from same locality.

*Etymology*

The species epithet honours the great artist David Bowie who passed away prematurely in 2016, but whose music will continue to inspire the generations to come.

*Diagnosis*

Embolus base narrow, with relatively short gradually curving spiral terminating at a very slight angle (Fig. 10E).

*Spintharus davidbowiei* can be diagnosed from other *Spintharus* here treated based on the following unique mtDNA nucleotide substitutions at the following standard DNA barcode alignment positions: A (145), T (265), A (325), A (421), G (502), C (505), T (631). It can also be readily diagnosed from most other *Spintharus* based on the following partially shared nucleotide substitutions, and all other species by their unique combination: G (61, except *S. greerae*), C (74, except *S. davidattenboroughi*), C (115, except *S. michelleobamae*), C (263, except *S. barackobamai*), A (246, except *Spintharus manrayi*), A (424, except *S. ralli*).

*Description*

**Male:** Total length 2.97. Cephalothorax 1.14 long, 0.78 wide, high 0.65, pale yellow with black lateral stripe. Sternum 0.55 long, 0.55 wide, extending half way between coxae IV, pale yellow. Abdomen 2.13 long, 0.56 wide, 0.55 high. Eyes approximately equal in size ALE 0.11, AME 0.12 in diameter. All eyes within one eye diameter apart from each other excluding the posterior median, which are approximately two eye diameters apart at 0.13. Leg I femur 2.48, patella 0.35, tibia 1.56, metatarsus 2.18, tarsus 0.59. Leg 4 slightly longer than leg 1. Legs II and III yellow, legs I and IV yellow with red at junctions between patella and tibia and the tibia and metatarsus.

**Variation:** Only known from a single adult male, the holotype, and juvenile female.

*SPINTHARUS RALLI* CHOMITZ & AGNARSSON SP. NOV.

FIG. 11A–I

*Type material*

Holotype female from **USA**, Puerto Rico, Rio Grande, El Yunque, Coco Trail, 18.318779N, 65.770744W, 511 m, 16–19.vii.2011, team CarBio, in NMNH. Additional specimens from same locality and **USA**: Puerto Rico, Rio Grande, El Yunque, Mt. Britton, 18.295744N 65.790649W, 707 m, 16–19.vii.2011, team CarBio; Puerto Rico, Villalba, Toro Negro, 18.172979N 66.491798W, 889 m, 27–29.vii.2011, team CarBio; Puerto Rico, Rio Grande, El Yunque, Big Trees Trail, 18.308701N 65.7752W, 471 m, 16–19.vii.2011, team CarBio; Puerto Rico, Rio Grande, El Yunque, El Verde, 18.321688N 65.819908W, 323 m, 16–19.vii.2011, team CarBio. **Saint Kitts and Nevis:** St. Kitts, St. Christoph, Romney Manor 17.340483N, 62.741038W, 273 m, 15.ii.2013, team CarBio; Nevis, Round Road Trail, 17.14162N, 62.59573 3W, 308 m, 28.ii.2013, team CarBio.

*Etymology*

The species epithet honours Betty and Ray Rall, grandparents of the first author of the species.

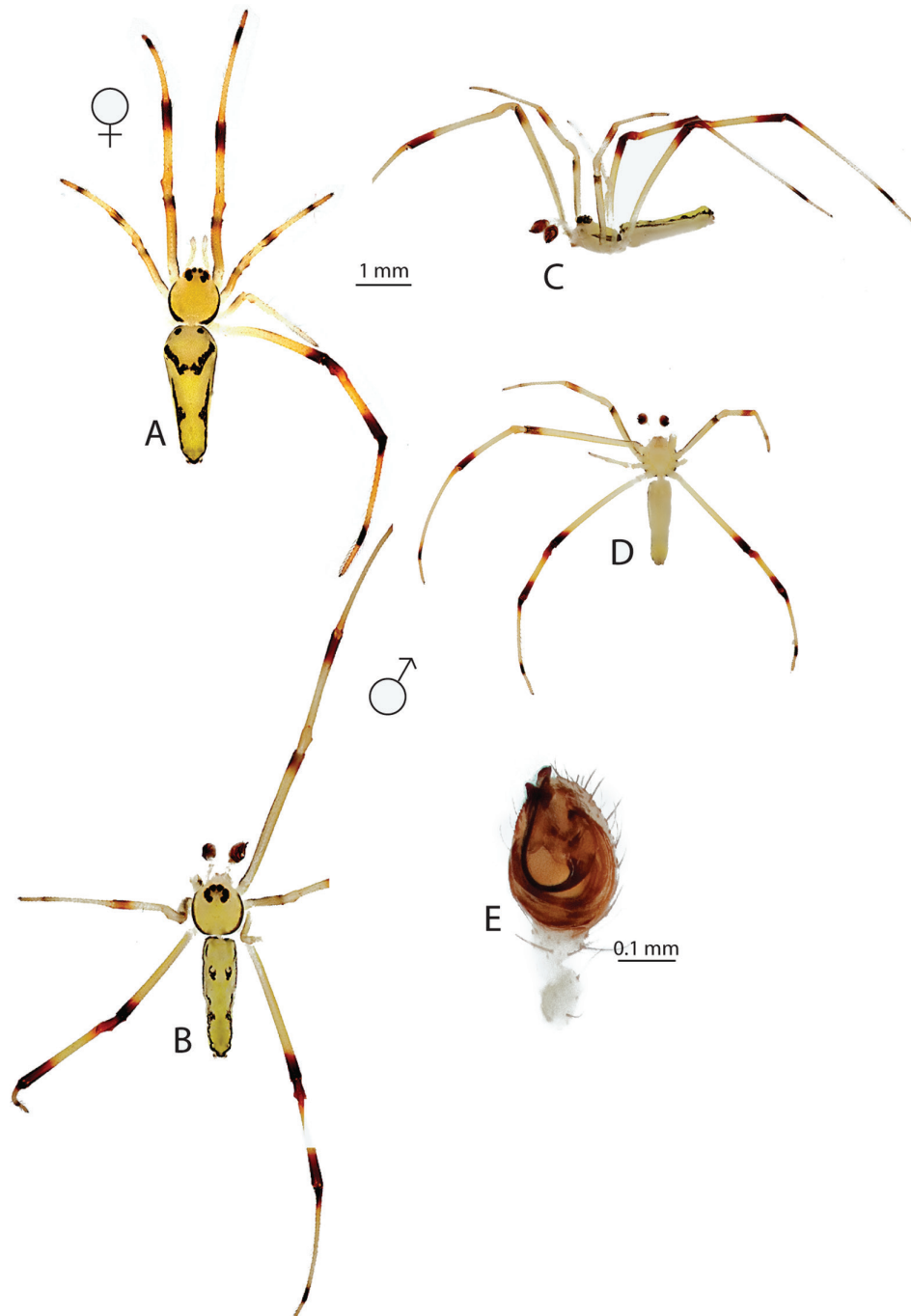
*Diagnosis*

Female abdomen oval, without humps (Fig. 11A–C). AWB, juxtaposed, PWB juxtaposed or fused. ADS separated by 3–4× their diameter, PDS further apart than ADS. RM limited to a U shaped form below AWB, and a line below PWB, only covering PDS. Embolus base narrow, only sclerotized at the beginning of spiral, with relatively thin gradually curving spiral terminating at a very slight angle (Fig. 11I).

*Spintharus ralli* can be diagnosed from other *Spintharus* here treated based on the following unique mtDNA nucleotide substitutions at the following standard DNA barcode alignment positions: G (7), A (58), C (193), T (316), G (479). It can also be readily diagnosed from most other *Spintharus* based on the following partially shared nucleotide substitutions, and all other species by their unique combination: G (16, except *S. manrayi* and *S. goodbreadae*), G (283, except *S. davidattenboroughi*), T (373, except *S. jesselaui*), A (424, except *S. davidbowiei*), G (472, except some *S. flavidus*), G (493, except *S. jesselaui*), T (517, except some *S. flavidus*), G (585, except *S. jesselaui*), T (628, except some *S. flavidus*).

*Description*

**Female:** Total length 3.87. Cephalothorax 1.25 long, 1.04 wide, 0.79 high, pale yellow with brown lateral

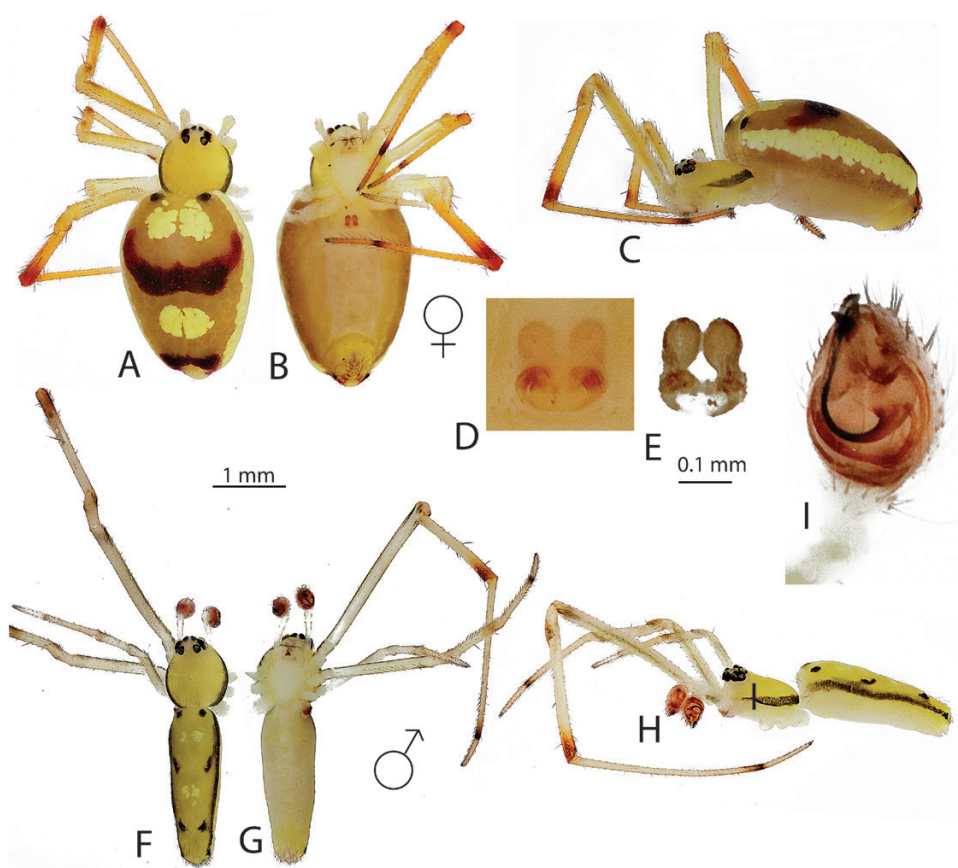


**Figure 10.** *Spintharus davidbowiei* Agnarsson & Chomitz **sp. nov.** A, juvenile female dorsal habitus. B–E, male. B–D, habitus: B, dorsal; C, lateral; D ventral. E, palp ventral.

stripe. Sternum 0.72 long, 0.57 wide, extending half way between coxae IV, pale yellow. Abdomen 2.58 long, 1.27 wide, 1.89 high. Eyes approximately equal in size ALE 0.10, AME 0.09 in diameter. All eyes within one eye diameter apart from each other excluding the posterior median, which are approximately 0.15 apart. Leg I femur 2.59, patella 0.43, tibia 1.56, metatarsus 2.53, tarsus

0.69. Leg IV slightly longer than leg 1. Legs II and III pale yellow. Legs I and IV yellow with red at junctions between patella and tibia and the tibia and metatarsus.

*Male:* Total length 2.99. Cephalothorax 1.00 long, 0.86 wide, high 0.60, pale yellow with brown lateral stripe. Sternum 0.64 long, 0.54 wide, extending half



**Figure 11.** *Spintharus ralli* Chomitz & Agnarsson **sp. nov.** A–E, female. A–C, habitus: A, dorsal; B, ventral; C, lateral. D–E, epigynum: D, ventral; E, digested dorsal. F–I, male. F–H, habitus: F, dorsal; G, ventral; H, lateral. I, palp ventral.

way between coxae IV, pale yellow. Abdomen 2.08 long, 0.77 wide, 0.74 high. Eyes approximately equal in size ALE 0.11, AME 0.10 in diameter. All eyes within one eye diameter apart from each other excluding the posterior median, which are 0.12 apart. Leg I femur 2.64, patella 0.44, tibia 1.57, metatarsus 2.47, tarsus 0.74. Legs II and III pale yellow. Leg I pale yellow with red patch where the tibia meets the metatarsus, also darkened junction between patella and tibia.

**Variation:** Female total length 3.43–3.87, cephalothorax 1.10–1.25, femur I 1.84–1.89. Male total length 2.64–2.99, cephalothorax 0.86–1.00, femur I 1.81–2.64.

***SPINTHARUS FROSTI* VAN PATTEN &  
AGNARSSON **SP. NOV.****

**FIG. 12A–I**

**Type material**

Holotype female from **Dominican Republic**, Valle Nuevo, Villa Pajón, 18.82208N 70.6838W, 2136 m, 25.vi.2012, team CarBio.

Additional specimens from same locality and **Dominican Republic**: San Jaun, Parque Nacional Armando Bermudez, Compartación Camp, 19.0375N 70.96918W, 2476 m, 29.vi.2012, team CarBio.

**Etymology**

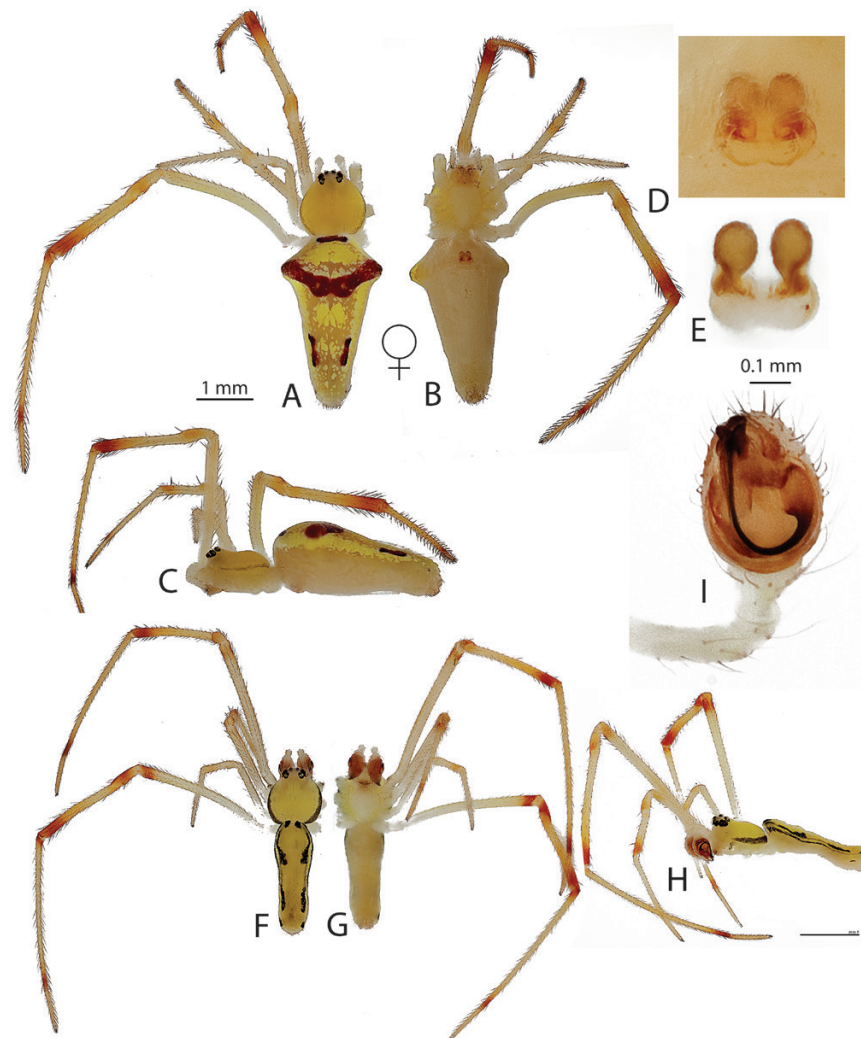
The species epithet honours Frost, a close friend of the first author of the species name.

**Diagnosis**

Female abdomen subtriangular with distinct humps (Fig. 12A–C). AWB and PWB fused. ADS and PDS about one diameter apart. RM limited to an anterior band, a broad V shaped form below AWB, and flanking lines below PWB, covering DSs. Embolus base narrow with a gradually curving spiral terminating at a very slight negative angle (Fig. 12I).

*Spintharus frosti* can be diagnosed from other *Spintharus* here treated based on the following unique mtDNA nucleotide substitution at the following standard DNA barcode alignment position: C (301). It can also be





**Figure 12.** *Spintharus frosti* Van Patten & Agnarsson **sp. nov.** A–E, female. A–C, habitus: A, ventral; B, dorsal; C, lateral. D–E, epigynum: D, ventral; E, digested dorsal. F–I, male. F–H, habitus: F, dorsal; G, ventral; H, lateral. I, palp ventral.

readily diagnosed from most other *Spintharus* based on the following partially shared nucleotide substitutions, and all other species by their unique combination: G (253, except *S. skelly* and *S. giraldoalayoni*), T (334, except *S. leonardodicaprio* and some *S. dayleae*), G (484, except some *S. skelly*), G (520, except *S. leonardodicaprio*).

### Description

**Female:** Total length 4.17. Cephalothorax 1.14 long, 1.20 wide, 0.70 high, pale yellow with faint brown lateral stripe. Sternum 0.59 long, 0.47 wide, extending half way between coxae IV, pale yellow. Abdomen 3.04 long, 1.78 wide, 1.30 high. Eyes approximately equal in size ALE 0.09, AME 0.08 in diameter. All eyes within one eye diameter apart from each other excluding the posterior median, which are 0.23 apart. Leg I femur

2.23, patella 0.51, tibia 1.56, metatarsus 2.35, tarsus 0.73. Leg IV slightly longer than leg I. Legs II and III pale yellow. Legs I and IV yellow with red at junctions between tibia and metatarsus.

**Male:** Total length 2.88. Cephalothorax 0.90 long, 0.91 wide, 0.92 high, pale yellow with black lateral stripe. Sternum 0.55 long, 0.52 wide, extending half way between coxae IV, pale yellow. Abdomen 1.95 long, 0.67 wide, 0.55 high. Eyes approximately equal in size ALE 0.08, AME 0.08 in diameter. All eyes within one eye diameter apart from each other excluding the posterior median, which are 0.18 apart. Leg I femur 2.16, patella 0.37, tibia 1.27, metatarsus 2.47, tarsus 0.71. Leg IV slightly longer than leg I. Legs II and III pale yellow. Legs I and VI with red patch where the tibia meets the metatarsus and the same red colour is also noted on the patellas.

**Variation:** Female total length 3.82–4.17, cephalothorax 1.12–1.14, femur I 2.04–2.23. Male total length 2.56–2.88, cephalothorax 0.85–0.90, femur I 2.16–2.59.

*SPINTHARUS SKELLY* VAN PATTEN &  
AGNARSSON **SP. NOV.**

FIG. 13A–I

*Type material*

Holotype female from **Dominican Republic:** La Vega, Armando Bermúdez National Park, Los Tablones, 19.05116N 70.88866W, 1304 m, 28.vi.2012, team CarBio.

Additional specimens from same locality and **Dominican Republic:** La Vega, Ebano Verde

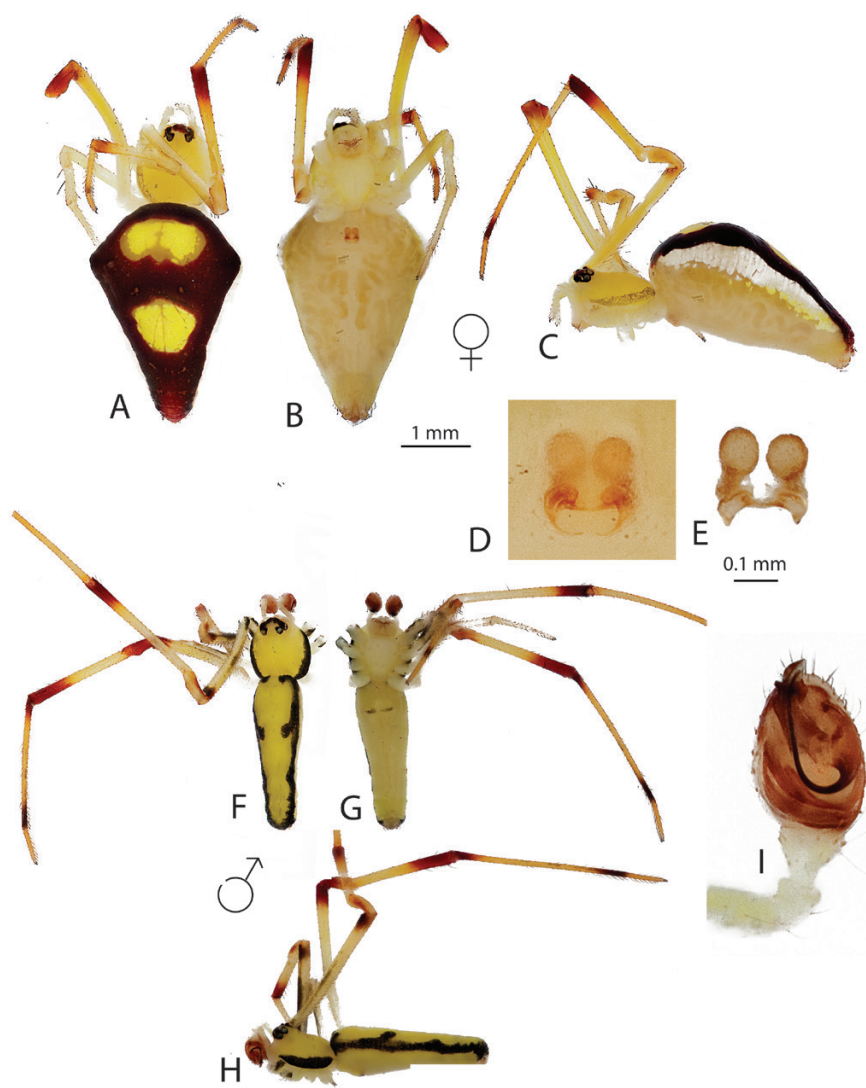
Scientific Reserve, 19.03627N 70.54337W, 1116 m, 27.vi.2012, team CarBio.

*Etymology*

The species is named after Skelly, the cat of the first author of the species.

*Diagnosis*

Female abdomen subtriangular with humps (Fig. 13A–C). AWB juxtaposed or fused, PWB fused. ADS and PDS indistinct, more than one diameter apart. RM extensive and continuous, covering DSs and tightly surrounding WBs. Embolus base narrow with abruptly curving,



**Figure 13.** *Spintarus skelly* Van Patten & Agnarsson **sp. nov.** A–E, female. A–C, habitus: A, ventral; B, dorsal; C, lateral. D–E, epigynum: D, ventral; E, digested dorsal. F–I, male. F–H, habitus: F, dorsal; G, ventral; H, lateral. I, palp ventral.

relatively thin spiral, terminating nearly in palpal plane (Fig. 13I).

*Spintharus skelly* can be diagnosed from other *Spintharus* here treated based on the following unique mtDNA nucleotide substitutions at the following standard DNA barcode alignment positions: C (334), G (451). It can also be readily diagnosed from most other *Spintharus* based the following partially shared nucleotide substitutions, and all other species by their unique combination: G (1, except *S. giraldoalayoni*), G (253, except *S. frosti* and *S. giraldoalayoni*).

### Description

**Female:** Total length 4.36. Cephalothorax 1.33 long, 1.19 wide, 0.81 high, pale yellow with faint brown lateral stripe. Sternum 0.71 long, 0.62 wide, extending half way between coxae IV, pale yellow. Abdomen 3.23 long, 2.14 wide, 1.62 high. Eyes approximately equal in size ALE 0.1, AME 0.09 in diameter. All eyes within one eye diameter apart from each other excluding the posterior median, which are 0.15 apart. Leg I femur 2.09, patella 0.59, tibia 1.52, metatarsus 2.47, tarsus 0.59. Leg IV slightly longer than leg 1. Legs II and III pale yellow. Legs I and IV yellow with red at junctions between tibia and metatarsus.

**Male:** Total length 3.06. Cephalothorax 0.98 long, 0.88 wide, 0.58 high, pale yellow with black lateral stripe. Sternum 0.71 long, 0.56 wide, extending half way between coxae IV, pale yellow. Abdomen 2.31 long, 0.79 wide, 0.73 high. Eyes approximately equal in size ALE 0.09, AME 0.10 in diameter. All eyes within one eye diameter apart from each other excluding the posterior median, which are 0.13 apart. Leg I femur 2.40, patella 0.43, tibia 1.93, metatarsus 1.88, tarsus missing. Legs II red at the joints between the tibia and metatarsus. Leg III has a black stripe down the side of the femur. Legs I and VI with red patch where the tibia meets the metatarsus and on the patella. Leg IV has a black spot where the tarsus meets the metatarsus.

**Variation:** Female total length 4.14–4.66, cephalothorax 1.15–1.22, femur I 2.64–2.75.

### *SPINTHARUS GIRALDOALAYONI* AGNARSSON & CHOMITZ SP. NOV.

#### FIG. 14A–I

### Type material

Holotype female from **Cuba**: Guantnamo, Baracoa, Alejandro Humboldt, El Yunque, 20.34501N 74.56642W, 370 m, 05.iv.2012, team CarBio.

Additional specimens from same locality.

### Etymology

The species epithet honours the great Cuban arachnologist Giraldo Alayón García, a key member of team CarBio and a leading authority on Caribbean arachnids.

### Diagnosis

Female abdomen subtriangular without humps (Fig. 14A–C). AWB and PWB fused. ADS and PDS indistinct, more than one diameter apart. RM limited to an anterior band, a broad V shaped form below AWB, and flanking lines below PWB, covering DSs. Embolus base broad with abruptly curving, relatively thin spiral, terminating nearly in palpal plane (Fig. 14I).

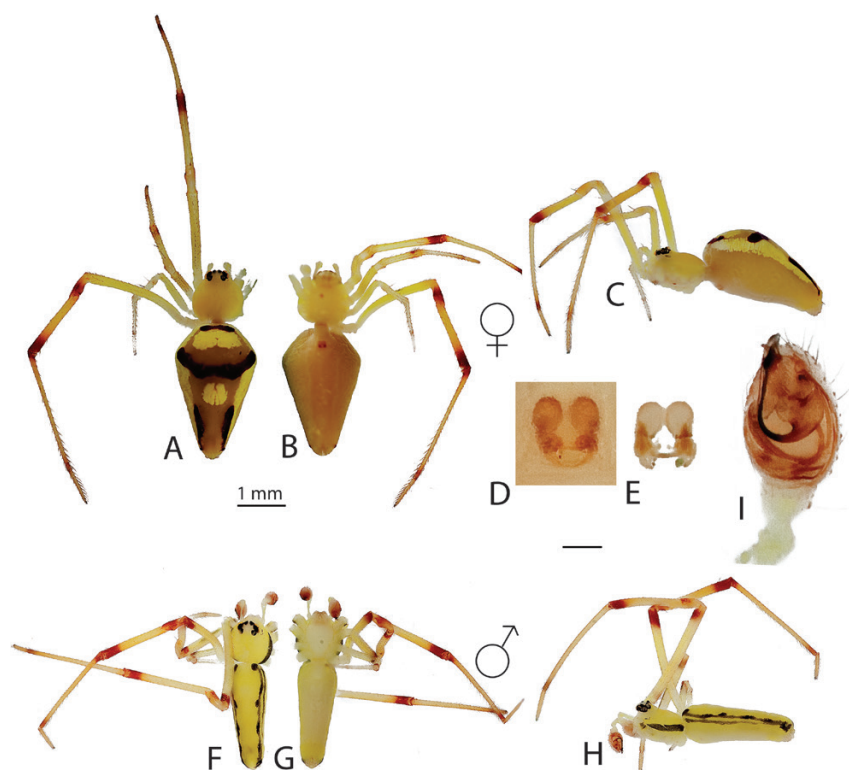
*Spintharus giraldoalayoni* can be diagnosed from other *Spintharus* here treated based on the following unique mtDNA nucleotide substitutions at the following standard DNA barcode alignment positions: G (4), G (446) It can also be readily diagnosed from most other *Spintharus* based on the following partially shared nucleotide substitutions, and all other species by their unique combination: G (1, except *S. skelly*), A (530, except *S. manrayi*), G (577, except some *S. flavidus*).

### Description

**Female:** Total length 4.13. Cephalothorax 1.36 long, 1.26 wide, 0.84 high, pale yellow with brown lateral stripe. Sternum 0.75 long, 0.77 wide, extending half way between coxae IV, pale yellow. Abdomen 2.98 long, 1.89 wide, 1.52 high. Eyes approximately equal in size ALE 0.10, AME 0.09 in diameter. All eyes within one eye diameter apart from each other excluding the posterior median, which are ~0.17 apart. Leg I femur 2.16, patella 0.55, tibia 1.61, metatarsus 2.32, tarsus 0.70. Leg IV slightly longer than leg 1. Legs II and III pale yellow. Leg I with red at junction between the tibia and metatarsus. Leg 4 with red junction between the tibia and metatarsus and a red patella.

**Male:** Total length 3.02. Cephalothorax 0.99 long, 0.95 wide, high 0.62, pale yellow with brown lateral stripe. Sternum 0.54 long, 0.71 wide, extending half way between coxae IV, pale yellow. Abdomen 2.10 long, 0.80 wide, 0.75 high. Eyes approximately equal in size ALE 0.10, AME 0.09 in diameter. All eyes within one eye diameter apart from each other excluding the posterior median, which are 0.15 apart. Leg I femur 1.89, patella 0.38, tibia 1.63, metatarsus 2.23, tarsus 0.56. Leg IV slightly longer than leg 1. Leg III pale yellow. Legs I II and IV pale yellow with red patch where the tibia meets the metatarsus, also darkened junction between patella and tibia.





**Figure 14.** *Spintharus giraldoalayoni* Agnarsson & Chomitz **sp. nov.** A–E, female. A–C, habitus: A, dorsal; B, ventral; C, lateral. D–E, epigynum: D, ventral; E, digested dorsal. F–I, male. F–H, habitus: F, dorsal; G, ventral; H, lateral. I, palp ventral.

**Variation:** Female total length 2.67–4.13, cephalothorax 0.91–1.26, femur I 2.15–2.16. Only a single adult male known.

***SPINTHARUS DAYLEAE* SARGEANT & AGNARSSON **SP. NOV.****

**FIG. 15A–K**

**Type material**

Holotype female from **Saint Lucia**, Piton Flor summit, 13.96448N 60.94473W, 540 m, 12.iv.2013, team CarBio.

Additional specimens from same locality and from **Grenada**: St Andrew Parish, Grenville, Grand Etang Lake, 12.09501N 61.6950W, 70 m, 1.iv.2013, team CarBio.

**Etymology**

The species epithet honours Dayle, the sister of the first author of the species.

**Diagnosis**

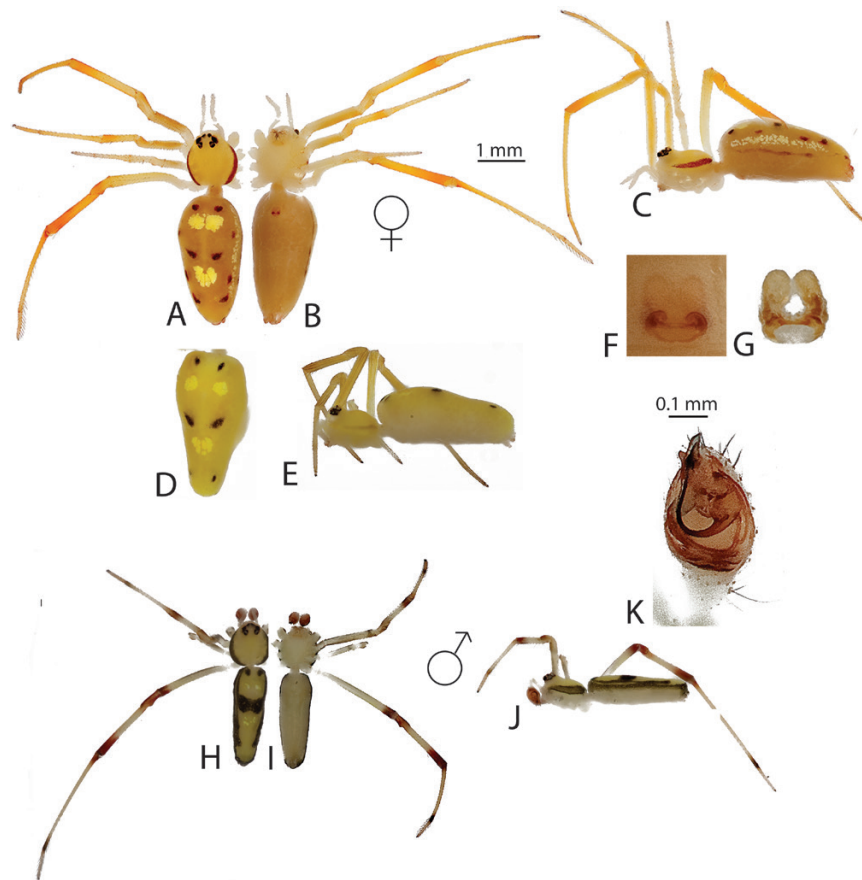
Female abdomen oval without humps (Fig. 15A–E). AWB separate or juxtaposed, PWB fused. ADS and

PDS more than two diameters. RM absent in available specimens. Embolus base broad with abruptly curving, relatively thin spiral, terminating nearly in palpal plane (Fig. 15K).

*Spintharus dayleae* can be diagnosed from other *Spintharus* here treated based on the following unique mtDNA nucleotide substitutions at the following standard DNA barcode alignment positions: T (266), C or A (268), T (283), T (412). It can also be diagnosed all *Spintharus* except some *S. flavidus* by G (286).

**Description**

**Female:** Total length 3.98. Cephalothorax 1.11 long, 1.05 wide, high 0.65, pale yellow with brown lateral stripe. Sternum 0.60 long, 0.62 wide, extending half way between coxae IV, pale yellow. Abdomen 2.64 long, 1.27 wide, 1.25 high. Eyes approximately equal in size ALE 0.09, AME 0.11 in diameter. All eyes within one eye diameter apart from each other excluding the posterior median, which are ~0.14 apart. Leg I femur 1.58, patella 0.41, tibia 1.43, metatarsus 2.40, tarsus 0.73. Leg IV slightly longer



**Figure 15.** *Spintharus dayleae* Sargeant & Agnarsson **sp. nov.** A–G, female. A–E, habitus: A, ventral; B, dorsal; C, lateral; D, dorsal juvenile; E, lateral juvenile. F–G, epigynum: F, ventral; G, digested dorsal. H–K, male. H–J, habitus: H, dorsal; I, ventral; J, lateral. K, palp ventral.

than leg 1. Legs I, II and III yellow, leg IV yellow with dark yellow patella and tibia.

**Male:** Total length 2.78. Cephalothorax 0.83 long, 0.81 wide, high 0.62, pale yellow with broad brown lateral stripe that is dark ventrally and fades lighter as it extends dorsally. Sternum 0.61 long, 0.50 wide, extending half way between coxae IV, pale yellow. Abdomen 1.83 long, 0.62 wide, 0.65 high. Eyes approximately equal in size ALE 0.08, AME 0.09 in diameter. All eyes within one eye diameter apart from each other excluding the posterior median, eyes which are 0.13 apart. Leg I femur 2.10, patella 0.38, tibia 1.26, metatarsus 2.16, tarsus 0.23. Leg II pale yellow with dark red patch where the tibia meets the metatarsus. Leg IV pale yellow with a dark patch where the femur meets the patella and where the tibia meets the metatarsus, dark brown/black coloration at the distal end of the metatarsus.

**Variation:** Female total length 3.45–3.98, cephalothorax 0.91–1.11, femur I 1.16–1.58. Male total length 2.83–4.42, cephalothorax 0.85–1.24.

***SPINTHARUS GOODBREADAE* CHOMITZ & AGNARSSON **SP. NOV.****

**FIG. 16A–I**

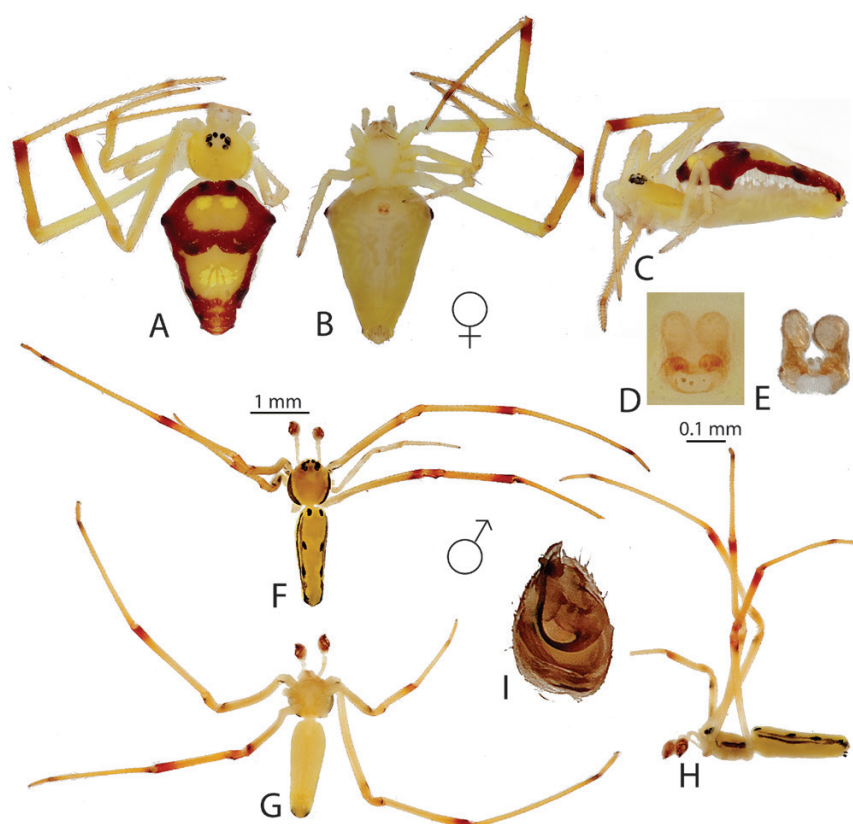
*Type material*

Holotype female from **Cuba**: Santiago de Cuba, Palma Mocha, 19.9333N 76.8833W, 60 m, 26.iii.2012, team CarBio.

Additional specimens from same locality and from **Cuba**: Granma, Turquino National Park, Aguada de Joaquin, 20.01303N, 76.86833W, 1634 m, 3.v.2013, Franklyn Riquelme; Granma, Turquino National Park, Bartolomé Masó, 20.01309N 76.83400W, 1154 m, 24–25.iii.2012, team CarBio; Gramna, Turquino National Park, Bartolomé Masó, 20.01742N 76.89781W, 940 m, 27–28.iii.2012, team CarBio; Gramna, Turquino National Park, La Platica, 20.00939N 76.89402W, 400 m, 3.v.2013, Franklyn Riquelme.

*Etymology*

The species epithet honours first author's paternal grandmother whose surname was Goodbread.



**Figure 16.** *Spintharus goodbreadae* Chomitz & Agnarsson **sp. nov.** A–E, female. A–C, habitus: A, ventral; B, dorsal; C, lateral. D–E, epigynum: D, ventral; E, digested dorsal. F–I, male. F–H, habitus: F, dorsal; G, ventral; H, lateral. I, palp ventral.

### Diagnosis

Female abdomen subtriangular with small humps (Fig. 16A–C). AWB separate, PWB fused. ADS large, separated by about their diameter, PDS more than four diameters apart. RM extensive and continuous covering DSs and surrounding WBs, extending to abdomen tip. Embolus base broad with abruptly curving, relatively thin spiral, terminating nearly in palpal plane (Fig. 16I).

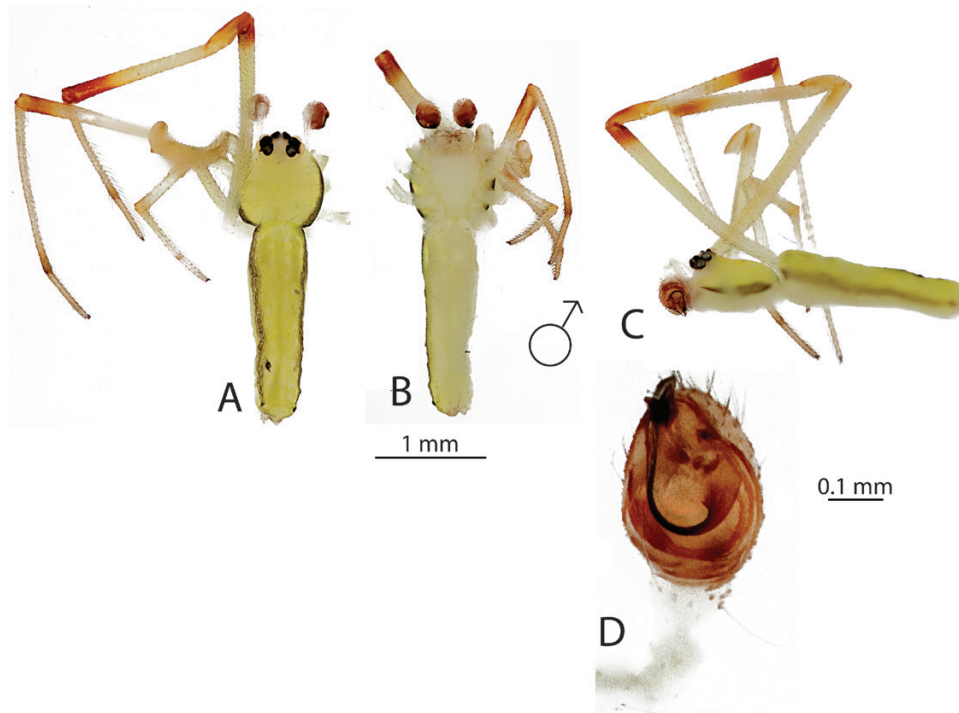
*Spintharus goodbreadae* can be diagnosed from other *Spintharus* here treated based on the following unique mtDNA nucleotide substitutions at the following standard DNA barcode alignment position: C (292). It can also be readily diagnosed from most other *Spintharus* based on the following partially shared nucleotide substitutions, and all other species by their unique combination: C (110, except *S. manrayi*), T (112, except *S. manrayi*), C (226, except *S. manrayi*).

### Description

**Female:** Total length 3.16. Cephalothorax 1.11 long, 1.04 wide, 0.67 high, pale yellow with faint brown

lateral stripe. Sternum 0.68 long, 0.59 wide, extending half way between coxae IV, pale yellow. Abdomen 2.58 long, 1.73 wide, 1.26 high. Eyes approximately equal in size ALE 0.09, AME 0.07 in diameter. All eyes within one eye diameter apart from each other excluding the posterior median, which are 0.15 apart. Leg I femur 2.03, patella 0.43, tibia 1.65, metatarsus 2.32, tarsus 0.60. Leg IV slightly longer than leg I. Legs II and III pale yellow. Legs I and IV yellow with red at junctions between patella and tibia and the tibia and metatarsus.

**Male:** Total length 2.54. Cephalothorax 0.90 long, 0.94 wide, 0.46 high, pale yellow with black lateral stripe. Sternum 0.48 long, 0.47 wide, extending half way between coxae IV, pale yellow. Abdomen 1.88 long, 0.77 wide, 0.53 high. Eyes approximately equal in size ALE 0.07, AME 0.07 in diameter. All eyes within one eye diameter apart from each other excluding the posterior median, which are 0.12 apart. Leg I femur 1.78, patella 0.40, tibia 1.14, metatarsus 1.84, tarsus 0.52. Leg IV slightly longer than leg I. Legs II and III pale yellow. Leg I with red patch where the tibia meets the metatarsus. Leg VI with red patch where



**Figure 17.** *Spintharus jesselaui* Sargeant & Agnarsson **sp. nov.** A–D, male. A–C, habitus: A, dorsal; B ventral; C, dorsal; D, palp ventral.

the tibia meets the metatarsus as well as a dark red patella.

**Variation:** Female total length 3.03–4.31, cephalothorax 0.97–1.22, femur I 1.87–2.72. Male total length 2.41–2.92, cephalothorax 0.76–0.96, femur I 1.78–2.33.

***SPINTHARUS JESSELAUI* SARGEANT &  
AGNARSSON **SP. NOV.****

**FIG. 17A–D**

*Type material*

Holotype male from **Dominica**: Syndacate Natiive Trail, 15.52394N 61.42049W, 540 m, 21.iv.2013, team CarBio.

No additional specimens.

*Etymology*

The species epithet honours Jesse Lauer, a friend of the first author of the species.

*Diagnosis*

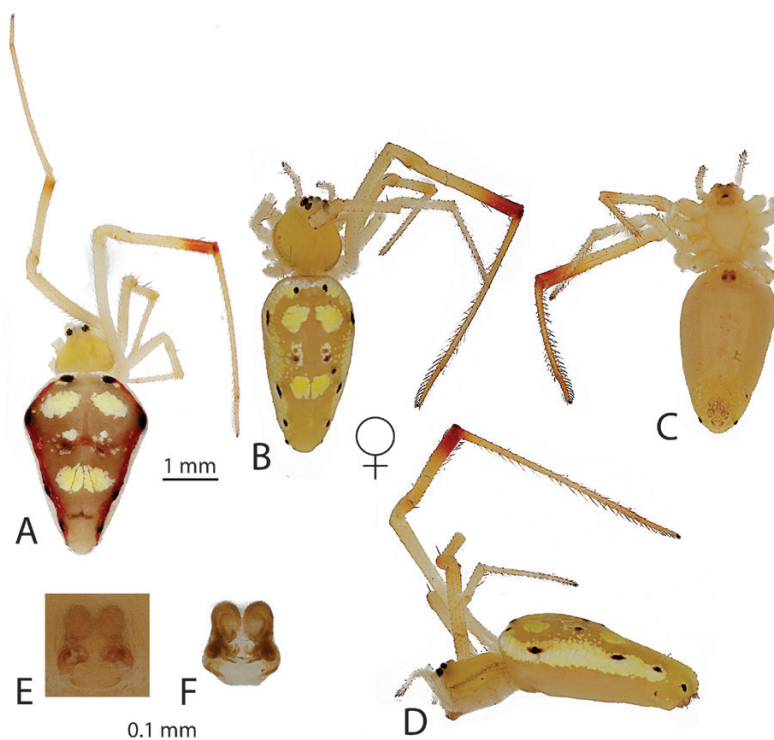
Embolus base narrow with abruptly curving, relatively thin spiral, terminating nearly in palpal plane (Fig. 17D).

*Spintharus jesselaui* can be diagnosed from other *Spintharus* here treated based on the following unique mtDNA nucleotide substitutions at the following standard DNA barcode alignment positions: A (59), G (190), G (538). It can also be readily diagnosed from most other *Spintharus* based on the following partially shared nucleotide substitutions, and all other species by their unique combination: A (202, except *S. flavidus*), C (287, except some *S. dayleae*), T (373, except *S. ralli*), G (493, except *S. ralli*), G (583, except some *S. goodbreadae*), G (585, except *S. ralli*).

*Description*

**Male:** Total length 2.62. Cephalothorax 0.81 long, 0.77 wide, high 0.48, pale yellow with brown lateral stripe. Sternum 0.54 long, 0.40 wide, extending half way between coxae IV, pale yellow. Abdomen 1.72 long, 0.49 wide, 0.45 high. Eyes approximately equal in size ALE 0.10, AME 0.08 in diameter. All eyes within one eye diameter apart from each other excluding the posterior median, which are 0.12 apart. Leg I femur 1.79, patella 0.47, tibia 1.35, metatarsus 0.92, tarsus 0.45. Leg IV slightly longer than leg I. Legs II and III pale yellow. Leg I pale yellow with red patch where the tibia meets the metatarsus. Leg IV pale yellow with red at junctions between patella and tibia and the tibia and metatarsus.





**Figure 18.** *Spintharus greerae* Sargeant & Agnarsson **sp. nov.** A–F, female. A–D, habitus: A, dorsal; B, dorsal juvenile; C, ventral; D, lateral. E–F, epigynum: E, ventral; F, digested dorsal.

**Variation:** Only known from holotype male.

***SPINTHARUS GREERAE* SARGEANT &  
AGNARSSON **SP. NOV.****

**FIG. 18A–F**

**Type material**

Holotype female from **Mexico:** Tabasco, San Cristobal. 17.72453N 92.5834W, 10 m, 5.viii.2014, team CarBio.

Additional specimens from same locality.

**Etymology**

The species epithet honours Greer, the sister of the first author of the species.

**Diagnosis**

Female abdomen subtriangular without humps (Fig. 18A–D). AWB separate, PWB juxtaposed or fused. ADS large, separated by more than their diameter, PDS indistinct about the same distance apart as ADS. RM faint but extensive and continuous covering PDS and surrounding PWB, extending to abdomen tip. Absent in front and not surrounding AWB.

*Spintharus greerae* can be diagnosed from other *Spintharus* here treated based on the following unique

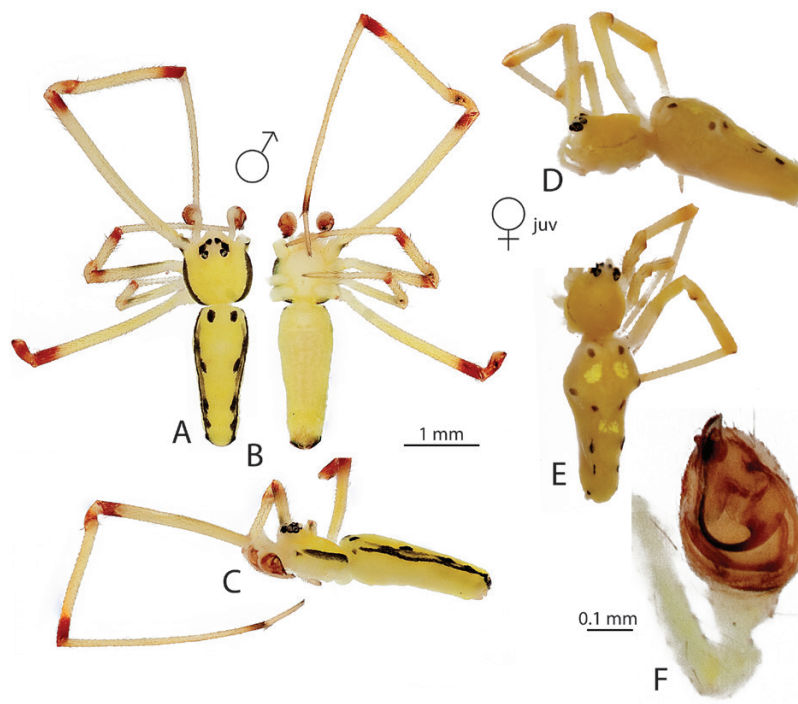
mtDNA nucleotide substitutions at the following standard DNA barcode alignment positions: G (67), G (88), T (184), T (217), A (232), G (383), T (625). It can also be readily diagnosed from most other *Spintharus* based on the following partially shared nucleotide substitutions, and all other species by their unique combination: G (28, except *S. flavidus*), G (61, except *S. davidbowiei*), A (205, except *S. flavidus*), A (206, except *S. flavidus*), A (316, except some *S. flavidus*), A (482, except *S. flavidus*).

**Description**

**Female:** Total length 4.13. Cephalothorax 1.10 long, 1.21 wide, 0.88 high, yellow with black lateral stripe. Sternum 0.91 long, 0.7 wide, extending half way between coxae IV, pale yellow. Abdomen 3.27 long, 1.71 wide, 1.23 high. Eyes approximately equal in size about ALE 0.11, AME 0.12 in diameter. All eyes within one eye diameter apart from each other excluding the posterior median, which are ~0.28 apart. Leg I femur 3.00, patella 0.71, tibia 2.11, metatarsus 3.14, tarsus 0.76. Leg IV slightly longer than leg 1. Legs II and III yellow, leg IV yellow with red at junctions between tibia and metatarsus.

**Male:** Unknown.

**Variation:** Total length 2.92 (subadult)–4.59, cephalothorax 0.88 (subadult)–1.27, femur 1 1.41 (subadult)–2.78.



**Figure 19.** *Spintharus manrayi* Chomitz & Agnarsson **sp. nov.** A–C, male habitus: A, dorsal; B, ventral; C, lateral. D–E, juvenile female habitus: D, lateral; E, dorsal. F, male palp ventral.



**Figure 20.** Distribution of specimens collected for this study, by the 16 species treated. The numerous other known localities of *Spintharus* are not indicated, as species identity cannot be clearly established based on morphology of DNA degraded museum specimens (see [Levi, 1963a](#)).

***SPINTHARUS MANRAYI* CHOMITZ &  
AGNARSSON SP. NOV.**

**FIG. 19A–F**

### *Type material*

Holotype female from **Cuba**: Gramna, Turquino National Park, Bartolomé Masó, 20.01742N 76.89781W, 940 m, 27–28.iii.2012, team CarBio.

Additional specimens from same locality and from **Cuba**: Granma, Turquino National Park, Bartolomé Maso, 20.01309N 76.83400W, 1154 m, 24–25.iii.2012, team CarBio; Gramna, Turquino National Park, La Platica, 20.00939N 76.89402W, 400 m, 3.v.2013, Franklyn Riquelme.

### *Etymology*

The species epithet honours the artist Man Ray, a relative of the first author of the species.

### *Diagnosis*

Embolus base narrow with abruptly curving, relatively thin spiral, terminating nearly in palpal plane (Fig. 19F).

*Spintharus manrayi* can be diagnosed from other *Spintharus* here treated based on the following unique mtDNA nucleotide substitutions at the following standard DNA barcode alignment positions: C (197), C (604). It can also be readily diagnosed from most other *Spintharus* based on the following partially shared nucleotide substitutions, and all other species by their unique combination: C (110, except *S. goodbreadae*), T (112, except *S. goodbreadae*), C (226, except *S. goodbreadae*), A (246, except *S. davidbowiei*), C (445, except some *S. flavidus*), A (530, except *S. giraldoalayoni*).

### *Description*

**Subadult female:** Total length 3.21. Cephalothorax 0.92 long, 0.80 wide, 0.72 high, pale yellow with faint black lateral stripe. Sternum 0.49 long, 0.54 wide, extending half way between coxae IV, pale yellow. Abdomen 2.17 long, 0.96 wide, 1.02 high. Eyes approximately equal in size ALE 0.09, AME 0.08 in diameter. All eyes within one eye diameter apart from each other excluding the posterior median, which are ~0.19 apart. Leg I femur 1.07, patella 0.31, tibia 1.00, metatarsus 1.33, tarsus 0.70. All legs pale yellow.

**Male:** Total length 2.79. Cephalothorax 0.89 long, 0.91 wide, 0.75 high, pale yellow with black lateral stripe. Sternum 0.60 long, 0.49 wide, extending half way between coxae IV, pale yellow. Abdomen 2.08 long, 0.78 wide, 0.58 high. Eyes approximately equal in size ALE 0.08, AME 0.09 in diameter. All eyes within one eye diameter apart from each other excluding the posterior

median, which are 0.15 apart. Leg I femur 2.58, patella 0.35, tibia 1.48, metatarsus 1.83, tarsus 0.57. Legs II and III with dark red patch where the tibia meets the metatarsus. Leg I with red patch where the tibia meets the metatarsus and at the proximal end of the patella.

**Variation:** Total length 2.29–2.79, cephalothorax 0.79–0.89, femur I 1.95–2.58.

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