

The subfamily Abbottellinae (Gastropoda: Annulariidae): origins, associations, and a review of the Hispaniolan taxa

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ABSTRACT

The subfamily Abbottellinae of the Annulariidae has been recognized as a speciose group in northern Hispaniola. This study, using phylogenetic (COI, 12S, H3), radular, and conchological characteristics, compared this group to other non-Hispaniolan annulariids to determine their wider associations and potential origin. Results indicate that the subfamily is related to the eastern Cuban *Annularisca* sensu lato and that genus should be moved to the Abbottellinae. The group dates from the time when eastern Cuba and northern Hispaniola were in close contact prior to tectonic movement. This is the first such zoogeographic connection reported for the family. The subfamily is not related to any Jamaican taxa tested. The Abbottellinae also do not occur on the southern Tiburon/Barahona peninsulas of Hispaniola, which has a different geologic history from the north. The eastern Cuban and Bahamian genus *Opisthosiphon* sensu lato was also shown to be a member of the subfamily. The nominal genus *Abbottella* is further divided into new genera based on these results. The new genera *Abbottipoma*, *Arenabbottella*, *Microabbottella*, and *Preclaripoma* are described. The new species *Rolleia simonaikeni* is described, and *Petasiopoma* is synonymized with *Rolleia*.

Additional Keywords: Zoogeography, phylogenetics, Cuba, Hispaniola, new taxa, terrestrial gastropods, land snails

INTRODUCTION

The land snail family Annulariidae is an exclusively Caribbean/Central American group. For its limited geographic distribution it is extremely speciose with >700 recognized taxa (Watters, 2006). The major centers of diversity are Cuba, Hispaniola, and Jamaica. The snails are strict calciphiles and many species are highly endemic to a particular mountain range, mogote, or outcrop. Of these, the genus *Abbottella* was phylogenetically identified as a discrete

clade apart from other annulariids by Skomrock (2014) and Watters and Larson (2017). Watters (2016b) formally raised the clade to subfamily level (Abbottellinae) based on additional radular and shell morphology characteristics. However, the questions of the origin of the subfamily and its relationships to other annulariids remained unanswered.

In all of the various schemes for higher annulariid systematics (Watters, 2006) subfamilies are distributed across the geographic range of the family – only the Abbottellinae, as previously understood, were endemic to a single portion of Hispaniola. Yet it may have been derived from elsewhere. In the Paleogene, proto-Central America was connected to Cuba and non-Tiburon Hispaniola, an association that may have lasted until the Eocene (Chakrabarty, 2006) or Miocene (Pindell, 1994) and provided ample time for faunal exchange. Since this time, these islands drifted east to their present positions, separating 20 to 25 million years ago (Pindell, 1994) and taking their snail faunas with them to further evolve in isolation. Buskirk (1985), reviewing the distributions of numerous groups of terrestrial animals (including snails) and pollen, also suggested a radiation from North and proto-Central America to the Greater Antilles by the Eocene. This would suggest a possible origin or connection for the abbottellines in Cuba or Jamaica.

This study examines the Abbottellinae based on phylogenetic, radular, and shell morphological considerations. In particular, membership to the subfamily is sought outside of Hispaniola in an attempt to determine: 1) if the group is indeed endemic to Hispaniola; 2) where might the origin of the group reside; and 3) what is its relation to the other subfamilies. Potential candidates are drawn from Cuba, Jamaica, and elsewhere based on similarities in shell morphology and radulae. Of particular interest are the similar-appearing *Annularia* of Jamaica and *Annularisca* of Cuba. In addition, the relationships between the recognized abbottelline genera are also examined.

Abbreviations used in the text are: ANSP, Academy of Natural Sciences, Philadelphia, Pennsylvania, USA; BMSM,

¹ *In absentia*

Bailey-Matthews National Shell Museum, Sanibel, Florida, USA; GTW, collection of the author, Columbus, Ohio, USA; MNHN, Muséum national d'Histoire naturelle, Paris, France; NHMUK, Natural History Museum, London, UK; OSUM, Ohio State University Museum of Biological Diversity, Columbus, Ohio, USA; UF, Florida Museum of Natural History, Gainesville, Florida, USA; USNM, National Museum of Natural History, Washington, DC, USA; ZMB, Zoologisches Museum Berlin, Federal Republic of Germany. Numbers in () after catalog numbers refer to the number of specimens.

MATERIALS AND METHODS

To evaluate the phylogenetic placement of the Abbottellinae and to understand relationships among genera within Abbottellinae, we collected molecular sequence data from 19 individuals from Abbottellinae and 28 individuals from Annulariidae and Pomatiidae (Appendix 1). We also downloaded data from 53 individuals from GenBank (NCBI nucleotide database) (Appendix 1). As outgroups, we used *Pomatias elegans* (Müller, 1774) and *Tudorella ferruginea* (Lamarck, 1822) from Pomatiidae, and, as a more distant outgroup, *Littorina littorea* (Linnaeus, 1758) from Littorinidae. Samples collected for this study were stored in ethanol after collection, and DNA was extracted from foot tissues of preserved specimens using Qiagen DNeasy Blood and Tissue Kits (Qiagen Hiden, Germany) following the manufacturers standard protocol. A region of the mitochondrial gene 12S was sequenced using primers developed by Watters and Larson (2017). A region of cytochrome oxidase 1 (COI) was sequenced using universal invertebrate primers LCOI490 and HCO2198 (Folmer et al. 1994). The nuclear gene histone 3 (H3) was amplified using primers H3aF and H3aR (Colgan et al., 1998). PCR products were cleaned using ExoSAP-IT (ThermoFisher Scientific) and sent to the Ohio State University Biomedical Research Tower for sequencing. Chromatograms were assembled in Geneious v6.1.7 (Kearse et al., 2012) and edited by eye when necessary. Sequences were aligned using the MUSCLE (Edgar, 2004) algorithm implemented in Geneious (Kearse et al., 2012) using default parameters.

The best model of nucleotide substitution and partitioning scheme was determined using PartitionFinder v2.1.1 (Lanfear et al., 2016). We used a greedy search scheme, considered all models of nucleotide substitution, and performed model selection using corrected AIC. A maximum-likelihood tree was inferred for COI using RAxML v8.2.10 (Stamatakis, 2014) as implemented on the Cipres Science Gateway (Miller et al., 2015). We used the partitioning scheme determined by PartitionFinder and the GTR model with Gamma rate variation. We used 100 bootstrap replicates to assess confidence in the inferred relationships. To infer a posterior distribution of gene trees, we used Bayesian

Inference in MrBayes v3.2.2 (Ronquist et al., 2012). We used the partitioning scheme and models determined by PartitionFinder. Two independent analyses were run for 5,000,000 generations over four chains, sampling every 1,000 generations. We discarded 25% of runs as burn-in, and we assessed convergence using Tracer v1.6.0 (Rambaut and Drummond, 2007).

To infer a more robust hypothesis of relationships between groups, we used a concatenated dataset including the mitochondrial COI and 12S genes and the nuclear gene H3. While this dataset included fewer taxa than the COI dataset, it included a larger data matrix. Given that many taxa within Abbottellinae and those grouping with Abbottellinae in the COI gene tree could be included in this dataset and that relationships between these groups were not well resolved using COI (see Results), we analyzed this dataset in an attempt to further resolve relationships between these groups. While we acknowledge that a coalescent-based analysis would have been ideal (Edwards et al., 2016), given the limited sampling (2 independent loci, not sampled in all specimens), only a concatenation approach was possible for this study. All samples for which at least two of the three genes were sequenced were retained for this analysis. As above, we used PartitionFinder to select the best model and partitioning scheme, RAxML to infer a maximum likelihood tree, and MrBayes to infer the posterior distribution of trees under Bayesian inference.

Descriptions and measurements were based on shells oriented with the spire up and the aperture facing the viewer. Measurements are for adult shells unless noted otherwise. Length was measured from the tip of the protoconch (or teleoconch of decollate specimens) to the opposite anterior-most extension of the outer lip. Subsets of the largest and smallest adult specimens were selected by eye from all available specimens and measured to determine the minimum and maximum lengths. The number of whorls was determined using the 1 D method of Van Osselaer (1999).

Detailed redescriptions, accounts, and translated original descriptions of species previously covered can be found in Watters (2013, 2016b) and are not duplicated here. Distribution maps are Google™ Earth Pro. Image Landsat. © 2019 DigitalGlobe. Data: SIO, NOAA, US Navy, NGA, GEBCO.

RESULTS

Our final COI alignment included 82 individuals and 582 base pairs. The concatenated alignment of COI, 12S, and H3 included 50 individuals and 1,351 base pairs. For COI, the best scheme determined using AIC in PartitionFinder included three partitions (first, second, and third codon positions). The best models of nucleotide substitution were TVM+G, TRN+I+G, and GTR+I for the first, second, and third codon positions, respectively. The best scheme identified by

PartitionFinder for the concatenated dataset included seven partitions: One for each codon position of COI and H3 (for a total of six) and a single partitioning scheme for 12S. The best models inferred by PartitionFinder were TRN, JC+I, K81UF+G, GTR+G, HKY+G, TRN+G, and GTR+I for the first, second,

and third codon positions of H3, 12S, and the first, second, and third codon positions of COI, respectively.

Abbottellinae was recovered as a monophyletic group (BS = 100, pp = 1.0) under both maximum likelihood and Bayesian inference of the COI gene tree (Figure 1), but there was not strong support for the relationship of this

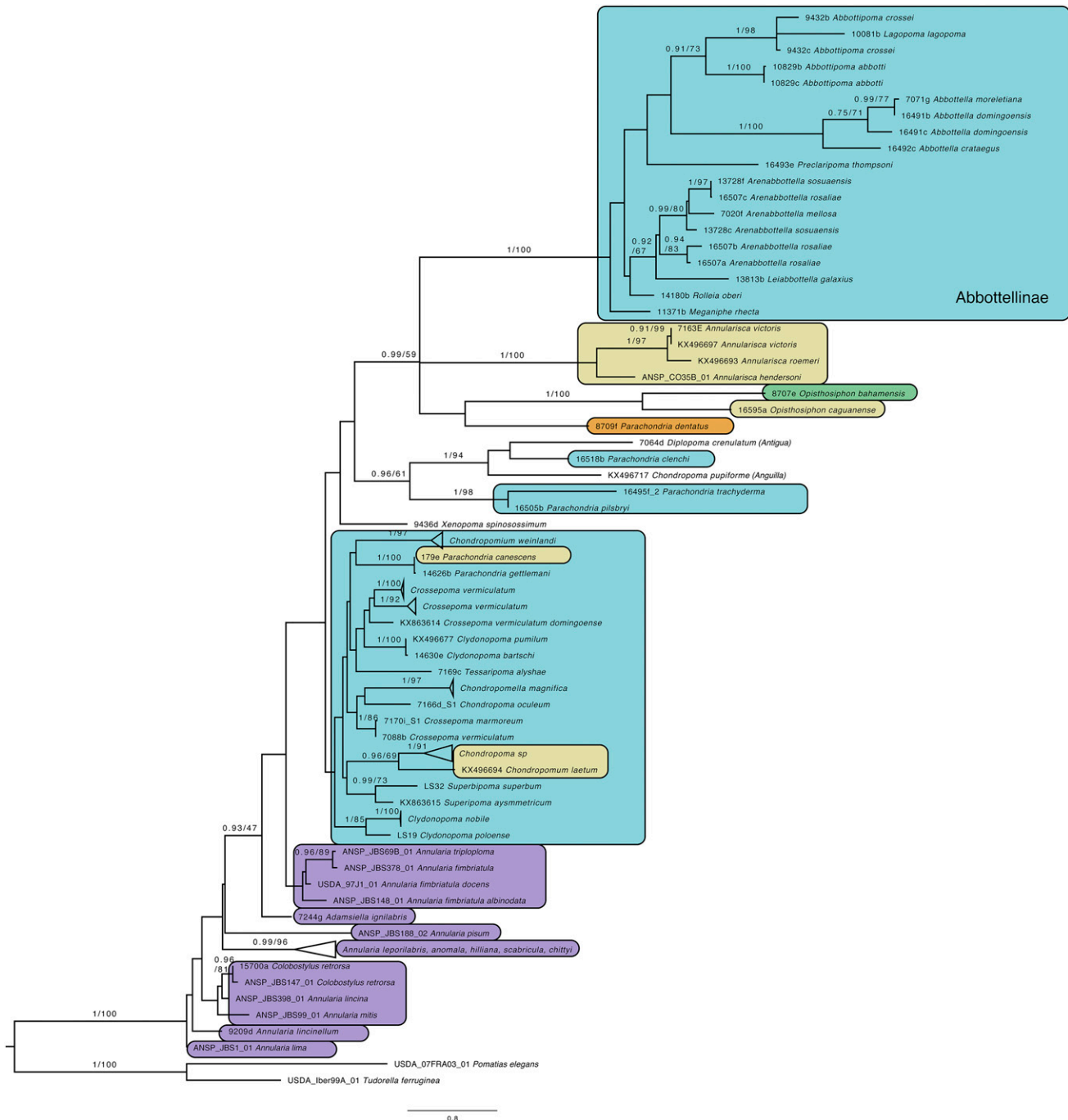


Figure 1. Maximum Likelihood tree based on COI. The numbers above the branches are posterior probability/ bootstrap support values. Support values are only shown for branches with either > 70 bootstrap support or >0.90 posterior probabilities. Taxa from the DR are highlighted in blue, taxa from Cuba are highlighted in yellow, taxa from the Bahamas are highlighted in green, taxa from Florida are highlighted in orange, and taxa from Jamaica are highlighted in purple. The Abbottellinae are labelled.

group to other sampled individuals. Within Abbottellinae, there were three moderately-to-well supported groups. One included *Abbottella moreletiana*, *Abbottella crataegus*, and *Abbottella domingoensis* (BS= 100, pp = 1.0). A moderately supported group (BS=73, pp = 0.91) included *Abbottipoma abbotti*, *Abbottipoma crossei*, and *Lagopoma lagopoma*. The third group included *Arenabbottella sosuaensis*, *Arenabbottella rosaliae*, *Arenabbottella mellosa*, and *Leiabbottella galaxius* (BS = 67, pp = 0.92). The placements of *Meganiphe rhexta*, *Rolleia oberi*, and *Preclaripoma thompsoni* with respect to other Abbottellinae were not well resolved in either analysis. The Bayesian analysis supported a group including the Hispaniolan abbottellines, *Annularisca*, *Opisthosiphon*, and *Parachondria dentatus* (BS = 59, pp = 0.99).

The maximum likelihood and Bayesian analyses of the concatenated dataset (Figure 2) also recovered the Abbottellinae as a monophyletic group (BS = 100, pp = 1.0). The same groups within Abbottellinae supported by the COI dataset were recovered with the concatenated dataset, and *Meganiphe rhexta* was recovered as sister to the group containing *Leiabbottella galaxius*, *Arenabbottella rosaliae*, and *Arenabbottella sosuaensis* (BS = 94, pp = 1.0). There was support (BS=75, pp = 0.98) for a clade including the Abbottellinae, *Annularisca*, *Opisthosiphon*, and *Parachondria dentatus*, but, as with the COI dataset, we could not resolve the relationships between these

groups. There was also moderate support (BS = 62, pp = 0.96) for the other *Parachondria* as sister to this clade.

DISCUSSION

MOLECULAR PHYLOGENETICS

The results of this study indicate that the Abbottellinae represents a distinct group well-supported by phylogenetic, radular, and conchological analyses. Though results were originally limited to the *Abbottella*-like taxa of Hispaniola, evidence presented here indicates this subfamily also includes the eastern Cuban *Annularisca* and *Opisthosiphon*. No abbottelline was found to cluster with any Tiburon/Barahona peninsular (e.g., *Chondropomella*, *Chondropomium*, *Clydonopoma*, *Superbipoma*) or Jamaican taxa.

Phylogenetic analyses supported the monophyly of Abbottellinae, based on the species included in this study. Future work should evaluate additional Abbottellinae to further test monophyly of the group. However, given that this is the first attempt at a molecular phylogeny in this group and samples for DNA analyses are limited for some species, these results are promising. Results also supported the monophyly of the genera *Abbottella* and *Arenabbottella*. The results presented here do not support the monophyly of *Abbottipoma* with respect to *Lagopoma*, and future work should include

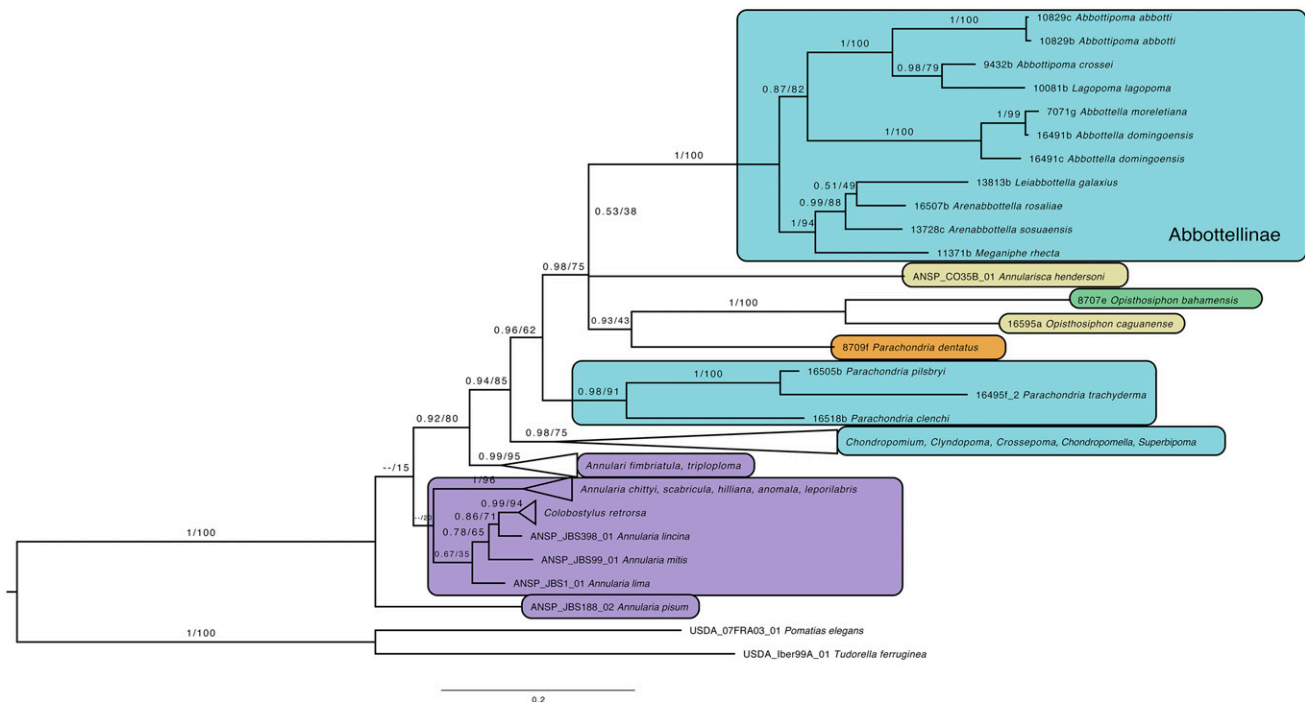


Figure 2. Maximum Likelihood tree based on the concatenated dataset. The numbers above the branches are posterior probability/ bootstrap support values. Taxa from the DR are highlighted in blue, taxa from Cuba are highlighted in yellow, taxa from the Bahamas are highlighted in green, taxa from Florida are highlighted in orange, and taxa from Jamaica are highlighted in purple. The Abbottellinae are labelled.

additional representatives from *Lagopoma* to evaluate the monophyly of this group.

The Jamaican genera *Annularia* Schumacher, 1817, *Colobostylus* Crosse and Fischer, 1888, and *Adamsiella* Pfeiffer, 1851, were not found to be related to the Abbottellinae in this study. Although *Annularia* taxa have a similar shell form to abbottellines, the similarity is apparently due to convergence.

Cuban *Annularisca*, Bajaman and Cuban *Opisthosiphon*, and *Parachondria dominguensis* from Key West grouped with Abbottellinae in this study. However, we were unable to resolve the relationships between these groups and Abbottellinae, either with the COI dataset, or with the concatenated dataset with more information. Both trees include a polytomy with *Annularisca*, *Opisthosiphon*, and *Parachondria dentatus*. Future work with additional loci may be necessary to resolve these relationships.

SYSTEMATICS

Torre and Bartsch (1941) finely divided a large group of similar Cuban species into several subgenera, all of which they placed under *Annularia* Schumacher, 1817. *Annularia* is now considered a Jamaican endemic genus. Their subgeneric taxa were differentiated by minor differences in the strength of the sculpture and form of the lip. These taxa included: *Annularella*, *Annularisca*, *Annularosa*, *Chondropomatus*, all Henderson and Bartsch, 1920, and *Annularex* and *Lugarenia*, both Torre and Bartsch, 1941. Watters (2006) consolidated all of these under the genus *Annularisca*, although *Lugarenia* is probably not related. They are all endemic to eastern Cuba. In addition to being phylogenetically sister to the Hispaniolan abbottellines, they share the same “Mitten” type radula (see below), similar opercular structure, and shell sculpture. *Annularisca* shell forms are very similar to *Abbottella* but consistently differ from those of other annulariids: low turbinoid, non-decollate, openly umbilicate shells. Cuban *Annularisca* species appear to be larger versions of Hispaniolan abbottellines (Figures 3–7). With the exception of *Lugarenia*, all of these Cuban taxa are here moved to the Abbottellinae.

Opisthosiphon was found to be part of the Abbottellinae clade as well. This genus (and its various subgenera) are widespread in eastern Cuba and the Bahamas, with numerous nominal species. Watters (2006) reduced the ten subgenera of previous workers to three. No species are known from Hispaniola, Puerto Rico, or Jamaica. It is probable that the genus originated in Cuba and has dispersed throughout the Bahamas by rafting. *Opisthosiphon* have “breathing” devices—structures that allow the animal to communicate with the outside when the operculum is withdrawn. This device varies from a simple pore to (more often) a short reflected siphon or snorkel. However, *Opisthosiphon* shares the “Mitten” type radula with abbottellines. It differs from the rest of the abbottellines in the following

ways: the rhytidopomine operculum (pin-wheel extensions across the operculum rather than the single spiral lamellum of other abbottellines); the shells are decollated in *Opisthosiphon* but entire in the remainder of other abbottellines; the shell shape of *Opisthosiphon* is pupoid in overall shape rather than depressed turbinoid. Given the diversity of *Opisthosiphon* species in neighboring eastern Cuba, it is peculiar that none exist in Hispaniola. It is possible they did at one time but have been extirpated.

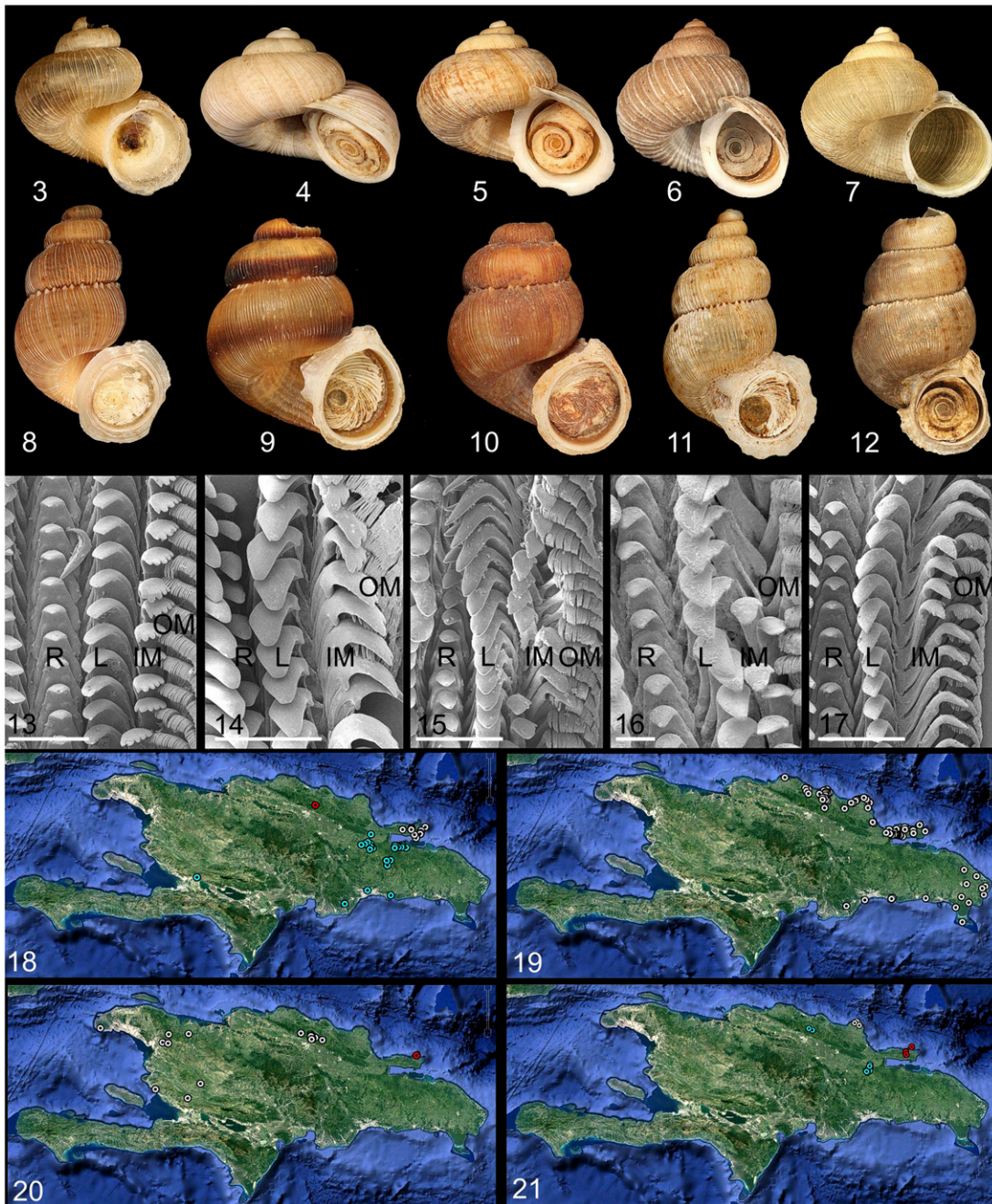
Opisthosiphon has been included in the Rhytidopominae, a heterogeneous group (as envisioned by Henderson and Bartsch, 1920) of Cuban taxa that Watters (2006) placed under the Chondropomatinae – a scheme that can no longer be maintained based on these results. The type genus is *Rhytidopoma* Sykes, 1901, based on the Cuban *Cyclostoma rugulosum* Pfeiffer, 1839, which resembles *Opisthosiphon* and has a breathing device as well. No *Rhytidopoma* taxa were available for this study. This presents a potential problem in the taxonomy of the Abbottellinae. If *Rhytidopoma* is part of the *Abbottella* clade, the nomen Rhytidopominae Henderson and Bartsch, 1920, would have precedence over Abbottellinae Watters, 2016. Future studies involving additional Cuban taxa may well show that not only *Abbottella* and *Opisthosiphon*, but *Rhytidopoma* and similar groups such as *Ramsdenia* Preston, 1913, and *Cubadamsiella* Torre and Bartsch, 1941, are related in one clade under Rhytidopominae that spans northern Hispaniola, eastern Cuba, and the Bahamas. Representative members of *Opisthosiphon* are shown in figures 8–12.

The Floridian *Parachondria dentatum* (Say, 1825) grouped here with *Opisthosiphon* although it lacks a breathing device. As noted by Watters (2016a), “*Parachondria*” is a wide-ranging catch-all group that undoubtedly contains numerous unrelated taxa in unnamed genera; the type of the genus is Jamaican. *Parachondria dentatum* is very similar to *Opisthosiphon* and is here considered a relative of that group lacking a siphon; it may require a new generic name.

ZOOGEOGRAPHY

The Hispaniolan Abbottellinae do not occur in the Tiburon/Barahona peninsulas, which have a different geological history and a unique annulariid fauna apart from the remainder of northern Hispaniola, here designated Hispaniola(N). Occupying two different tectonic plates, the Tiburon Peninsula and Hispaniola(N) have been colliding since perhaps the Oligocene (van Benthem et al., 2013) but have exchanged very few annulariid genera. Based on the results presented here, the abbottellines are more closely related to taxa from eastern Cuba than they are with those from the Tiburon Peninsula, with which they share the island. This is the first such zoogeographic connection reported for the family.

Central to the understanding of this zoogeographic puzzle is the geologic history of the Caribbean. Eastern



Figures 3–21. *Annularisca*, *Opisthosiphon*, radular types, distribution maps of genera. **3–7.** Representative Cuban *Annularisca*. **3.** *Annularisca mayariensis* (Torre and Bartsch, 1941). GTW 14027a, Cantera de Mella, 11.7 mm diameter. **4.** *Annularisca auricoma putre* (Pfeiffer, 1863). GTW 7175a, Tortuguilla, 11.8 mm diameter. **5.** *Annularisca heynemanni* (Pfeiffer, 1864). GTW 14026a, Maisi, 14.2 mm diameter. **6.** *Annularisca victoris* (Torre and Bartsch, 1941). GTW 7163d, Maisi, 12.1 mm diameter. **7.** *Annularisca mackinlayi* (Pfeiffer, 1859). GTW 14458a, Yateras, 11.7 mm diameter. **8–12.** Representative *Opisthosiphon*. **8.** *Opisthosiphon moreletianum* (Petit, 1850). GTW 7141b, Isla de Juventud, Cuba, 14.8 mm length. **9.** *Opisthosiphon berryi* Clapp, 1919. GTW 7076a, Paso Gunaja, Cuba, 8.4 mm length. **10.** *Opisthosiphon paredonense* Torre and Henderson, 1921. GTW 8050a, Paso de Los Paredones, Cuba, 10.3 mm length. **11.** *Opisthosiphon pupoides velazquezii* Torre and Bartsch, 1941. GTW 7140c, Isla de Juventud, Cuba, 13.8 mm length. **12.** *Opisthosiphon cucullatum* Torre and Bartsch, 1941. GTW 16588a, Calvario, Cuba, 16.4 mm length. **13–17.** Radular types. R – rachidian; L – lateral; IM – inner marginal; OM – outer marginal. Bar = 100 μ . **13.** Glove – *Halotudora sumichrasti* (Crosse and Fischer, 1874). Mexico. **14.** Hook – *Chondropomium marmoreum* (Watters and Duffy, 2010). Dominican Republic. **15.** Mitten – *Arenabbottella rosaliae* (Pfeiffer, 1858). Dominican Republic. **16.** Mitten – *Annularisca roemeri* (Pfeiffer, 1864). Cuba. **17.** Mitten – *Opisthosiphon bahamense* (Pfeiffer, 1865). Bahamas. **18–21.** Distribution maps of genera. **18.** white – *Abbottipoma*; blue – *Abbottella*; red – *Meganiphe*. **19.** white – *Arenabbottella*. **20.** white – *Rolleia*; red – *Microabbottella*. **21.** white – *Leiabbottella*; red – *Lagopoma*; blue – *Preclaripoma*.

Cuba and Hispaniola(N) were connected beginning with the Oligocene (Rosen, 1976; Judd, 2001; Ottenwalder, 2001), with Puerto Rico connected with eastern Hispaniola(N) from the middle Eocene to lower Miocene (Ottenwalder, 2001). When these were contiguous during the middle Cenozoic it formed an emergent pathway for dispersal from eastern Cuba (then a separate island from the remainder of Cuba) to the Cordillera Septentrional in northern Hispaniola and eastward to Puerto Rico. As a result, most of the terrestrial snail groups in Puerto Rico (van der Schalie, 1948) also occur in eastern Cuba. Most Hispaniolan abbotellines are endemic to the northern Cordillera Septentrional and its extension into the Samaná Peninsula. Similarly, the Cuban *Annularisca* inhabits the Sierra Maestra, the eastern mountain range, which is tectonically related to the Cordillera Septentrional and was an avenue for dispersal to Hispaniola(N)—but not to the Tiburon/Barahona peninsulas.

Cuba has been a “hot-spot” for annulariids with much of the diversity of this family apparently originating on that island. Containing nearly 300 of the approximately 700 recognized species, the Cuban taxa are some of the most diverse and probably encompass multiple unique lineages. The central location of the island, its complex geologic history of being at least three distinct islands, and evidence of being at least partially emergent since the middle Eocene (Graham, 2003) gives support to this island as a major center for annulariid origination and dispersal.

In Hispaniola the northern Cordillera Septentrional is separated from the Cordillera Central to the south by the Cibao Basin (Oligocene–Pliocene) (Edgar, 1991). The Cordillera Central is largely metamorphic and supports very few of these calciphilic snails. South of the Cordillera Central is the Sierra de Neiba, which although composed of limestone has no Abbottellinae. Clearly the granitic Cordillera Central acts as a barrier to dispersal from the northern Cordillera Septentrional to the southern Sierra de Neiba, and the Sierra de Neiba is the gateway to the Tiburon/Barahona peninsulas.

Some abbotelline groups are endemic to the Samaná Peninsula of eastern Hispaniola(N), which is of late-Miocene or early-Pliocene origin (inundated until Miocene (Joyce, 1991)). This modern day peninsula was an island even in historic times (Ross, 1921). Gabb (1873: 161) noted “the Gran Estero which separates Samaná from the main-land was a century ago a navigable channel, but is now entirely closed. It is said to have been closed by drift and mud from the [Río] Yuna.” Cochran (1941: 2) commented: “Almost within the memory of the oldest inhabitant, Samaná Peninsula was an island separated from the main body of Hispaniola by a rapidly filling strait, in which pirate vessels were said to have lain in wait for richly laden merchantmen sailing for Europe.” It is likely that some of the Abbottellinae evolved on that island rather than being invaders from the mainland and have never left (e.g., *Abbottipoma*, *Lagopoma*, *Microabbottella*).

SYSTEMATICS

Annulariidae Henderson and Bartsch, 1920

Type Genus: *Annularia* Schumacher, 1817.

Description: Shells to 42 mm in length, planispiral to high-spired, often with reflected lip at maturity. Spire typically decollate. Many taxa wholly or partially solute. Shell sculpture usually present, rarely produced into short spines or serrations. Spiral sculpture usually as cords or threads, axial sculpture as lamellae. In some Cuban and Bahamian taxa breathing devices are developed, varying from simple punctures to elaborate internal or external siphons. Operculum present, varying from paucispiral to multispiral. Operculum often with calcareous deposit that may take the form of erect spiral lamellae, overlapping plates, or pin-wheel-like extensions. Very few species with obvious periostracum consisting of bristle-like projections.

Animals with bifid snout and foot longitudinally bisected into lateral lobes. Locomotion ditaxic between lobes of foot. Snout produced into two short accessory tentacles that continuously sample substrate. Sexes separate.

Taenioglossate radula with rachidian, single pair of laterals, and two pairs of marginals. Rachidian and lateral teeth usually unicuspid, very rarely multicuspid. Inner marginal multicuspid. Outer marginal pectinate.

Remarks: The taenioglossate radula of annulariids is very conservative and only the inner marginal is of sufficient variability to be systematically informative. This tooth is categorized here as either a Glove, a Mitten, or a Hook based on its overall shape. The Glove type has a broad inner marginal tooth divided into blunt, shallowly indented cusps of varying strength and number (Figure 13). The Hook radula has a blunt, triangular tooth with weak cusps along the distal margin and a pronounced basal hook on the proximal side (Figure 14). The Mitten type has an elongated triangular tooth characterized by a single, small basal tooth on the distal side, rarely accompanied by weak serrations along the remainder of the distal margin (Figure 15). The Glove type is by far the most common radular type seen in >100 annulariid species examined (Watters, unpubl.). In contrast the Mitten type is the only radula found in the Abbottellinae (as here defined), including *Annularisca* (Figure 16) and *Opisthosiphon* (Figure 17). The Hook type is unique to a few genera (e.g., *Clydonopoma*) isolated on the Tiburon Peninsula of Hispaniola.

These snails spend an inordinate amount of time making more snails. Pairs are often found in a mating position even during dormant periods, with the male attached to the female on her right side. There appears to be a distinct sexual color dimorphism in some species (e.g., *Rolleia oberi*).

Many annulariids are highly endemic (Watters, 2017). The entire distribution of some species may consist of only a few kilometers (or less) of suitable habitat. Goodfriend and Mitterer (1988, 1993) found that

terrestrial snails in Jamaica have had relatively long spans of endemism, remaining in a single locality for thousands of years. They suggested that many terrestrial snails, at least in Jamaica, have persisted in place from the Late Pleistocene to the present (Goodfriend and Mitterer, 1988, 1993). Similarly, many of the main lineages within Annulariidae apparently have persisted for long periods of time and are the result of the separation and emergence of the major landmasses followed by the fragmentation of populations into discrete, isolated species.

Abbottellinae Watters, 2016

Description: Shells to 15 mm in diameter, pupoid to turbinoid to planispiral, with reflected lip at maturity. Spire decollate only in *Opisthosiphon* and relatives. Some taxa partially or completely solute. Shell sculpture usually present, varying from smooth to pustulose to short spines or serrations. Spiral sculpture, when present, of cords or threads, axial sculpture, when present, as lamellae. Operculum present, as multispiral, single, erect, calcareous plate or with pin-wheel ribs across surface in *Opisthosiphon* and relatives. Very few species with periostracum consisting of bristle-like projections. Radula taenioglossate, of Mitten type.

Remarks: In contrast to most annulariids, most abbottelline species normally have a nondecollated spire. But like other annulariids abbottellines may suspend themselves from mucus strands when at rest. This behavior has been found in numerous annulariid groups from many localities. It is not found in the sister group Pomatiidae and it must be a very ancient behavioral trait unique to the Annulariidae.

Key to Hispaniola Genera

- 1) Shell sculptureless or having only weak spiral cords in umbilicus 2
- 1) Shell not as above 3
- 2) Outer lip narrowly expanded *Leiabbottella*
- 2) Outer lip widely expanded *Preclaripoma*
- 3) Axial sculpture of widely spaced, prominent, erect, web-like lamellae *Meganiphe*
- 3) Axial sculpture not as above 4
- 4) Sculpture spiny or serrated 5
- 4) Sculpture not as above 6
- 5) Shell nearly planispiral *Abbottella*
- 5) Shell turbinoid *Abbottipoma*
- 6) Outer lip notched and enrolled *Lagopoma*
- 6) Outer lip not as above 7
- 7) Axial sculpture tightly packed, forming almost continuous layer, with prominent spiral keels ...
..... *Microabbottella*

- 7) Sculpture not as above 8
- 8) Spiral sculpture weaker than axial sculpture
..... *Rolleia*
- 8) Spiral sculpture stronger than axial sculpture
..... *Arenabbottella*

Genus *Abbottella* Henderson and Bartsch, 1920

Type Species: *Chondropoma moreletianum* Crosse, 1873, by original designation.

Description: Shell small (ca. 8–15 mm in diameter), depressed to planispiral, widely-umbilicate. Non-decollate. Widely expanded, often fimbriated or undulating outer lip, auriculate. Axial and spiral sculpture forming sharp cusps or serrations at their intersections. Multispiral operculum with erect or reflected, single calcified spiral lamella.

Distribution: Central Dominican Republic from the south coast to the Majugual area and the southern shore of Samaná Bay (but apparently absent from the Samaná Peninsula); only a single species has been found in Haiti (Figure 18).

Remarks: An undescribed species is known from a single specimen from San Pedro de Mécoris.

Etymology: William Louis Abbott (1860–1936), American physician, ornithologist, field naturalist, and patron of the United States National Museum, now National Museum of Natural History (USNM).

Key to Species

- 1) Sculpture of very fine spiral cords and axial lamellae, forming minute denticles, Haiti haitensis
- 1) Sculpture coarse, forming denticles or thorny points, Dominican Republic 2
- 2) Final whorl with 40–80 axial lamellae, sculpture minutely serrated domingoensis
- 2) Final whorl <50 axial lamellae, sculpture thorny 3
- 3) Final whorl with 30–40 axial lamellae, spiral opercular lamella reflected back over base crataegus
- 3) Final whorl with 40–50 axial lamellae, spiral opercular lamella oblique but erect moreletiana

Abbottella crataegus Watters, 2016

(Figures 18, 22–28)

CHRESONYMY

Abbottella crataegus Watters, 2016: 116–117, figs. 17–24, 29.

Type Material: Holotype: UF 216138; Paratypes: UF 216138(5), from the type locality.

Type Locality: “5 km W of Majagual, Monte Plata Province, Dominican Republic.”

Distribution and Habitat: Known only from the limestone outcrops near Majagual and Guaragao. This is the western part of the Cevicos Formation composed of karsted, massive limestone of upper Miocene–lower Pliocene age (Draper and Lewis, 1991). All specimens seen were found between 100–260 m elevation. Entire distribution may be <80 km². Snails live on mesic limestone outcrops.

Etymology: *L. crataegus*, a flowering thorny plant, a masculine noun in apposition.

***Abbottella domingoensis* Bartsch, 1946**
(Figures 18, 29–36)

CHRESONYMY

Abbottella moreletiana gabriella Bartsch, 1946: 146, 148, pl. 25, figs. 4–6; Watters, 2006: 362.

Abbottella moreletiana wetmorei Bartsch, 1946: 146, 148, pl. 26, figs. 8–10.

Abbottella moreletiana domingoensis Bartsch, 1946: 147, pl. 25, figs. 1–3; Watters, 2006: 361–362.

Abbottella (Abbottella) moreletiana domingoensis (Crosse, 1873): Watters, 2006: 362.

Abbottella (Abbottella) moreletiana gabriella Bartsch, 1946: Watters, 2006: 83, 362; Watters, 2016b: 114–116 [in synonymy of *A. domingoensis*].

Abbottella (Abbottella) moreletiana wetmorei Bartsch, 1946: Watters, 2006: 83, 362.

Abbottella (Abbottella) domingoensis (Crosse, 1873): Watters, 2016b: 114–116, figs 9–16, 30.

Type Material: *Abbottella moreletiana domingoensis* Bartsch, 1946: Bartsch (1946) listed USNM 504118 as the holotype; this is now USNM 504117. *Abbottella moreletiana gabriella* Bartsch, 1946: Holotype: USNM 504124. *Abbottella moreletiana wetmorei* Bartsch, 1946: Holotype: USNM 504119.

Type Locality: *Abbottella moreletiana domingoensis* Bartsch, 1946: ““Santo Domingo,” probably Santo Domingo City.” *Abbottella moreletiana gabriella* Bartsch, 1946: “San Gabriel Isle, Samaná Bay.” *Abbottella moreletiana wetmorei* Bartsch, 1946: “Pelican Keys, San Lorenzo Bay, Samaná Bay, Dominican Republic.”

Distribution and Habitat: This species is found in the eastern end of the Cordillera Septentrional and the northern Cordillera Oriental in the Río Yuna valley and its tributaries; also in the low hills of the Los Ranchos Formation in the Sierra de El Seibo extending south to Santo Domingo and Boca Chica. It has been found under rocks and rubble on mesic limestone ridges where it is

locally common. All specimens seen were found below 320 m elevation.

Remarks: *Abbottella moreletiana gabriella* Bartsch, 1946, is known only from San Gabriel Isle, just east of Boca del Infierno, possibly from the San Gabriel Cave (Angel Cave). *Abbottella moreletiana wetmorei* Bartsch, 1946, is known from the Pelican Keys. Both are here regarded as stunted forms of *A. domingoensis*. The name *Abbottella domingoensis* Bartsch, 1946, is here chosen as the valid name despite the page precedence of these two forms.

Etymology: *Abbottella moreletiana domingoensis* Bartsch, 1946: from Santo Domingo. *Abbottella moreletiana gabriella* Bartsch, 1946: from San Gabriel Isle. *Abbottella moreletiana wetmorei* Bartsch, 1946: Frank Alexander Wetmore (1886–1978), American ornithologist at Smithsonian Institution.

***Abbottella haitensis* Bartsch, 1946**

(Figures 18, 37–39)

CHRESONYMY

Abbottella haitensis Bartsch, 1946: 143, 145–146, pl. 24, figs. 10–12.

Abbottella (Abbottella) haitensis Bartsch, 1946: Watters, 2006: 83, 287–288.

Type Material: Holotype: USNM 504111.

Type Locality: “[Haiti] on the road to Grand Bois, 4 miles north of Thomazeau, at an elevation of 1,000 feet.” We have not located this Grand-Bois.

Distribution and Habitat: Known only from the type locality without habitat information.

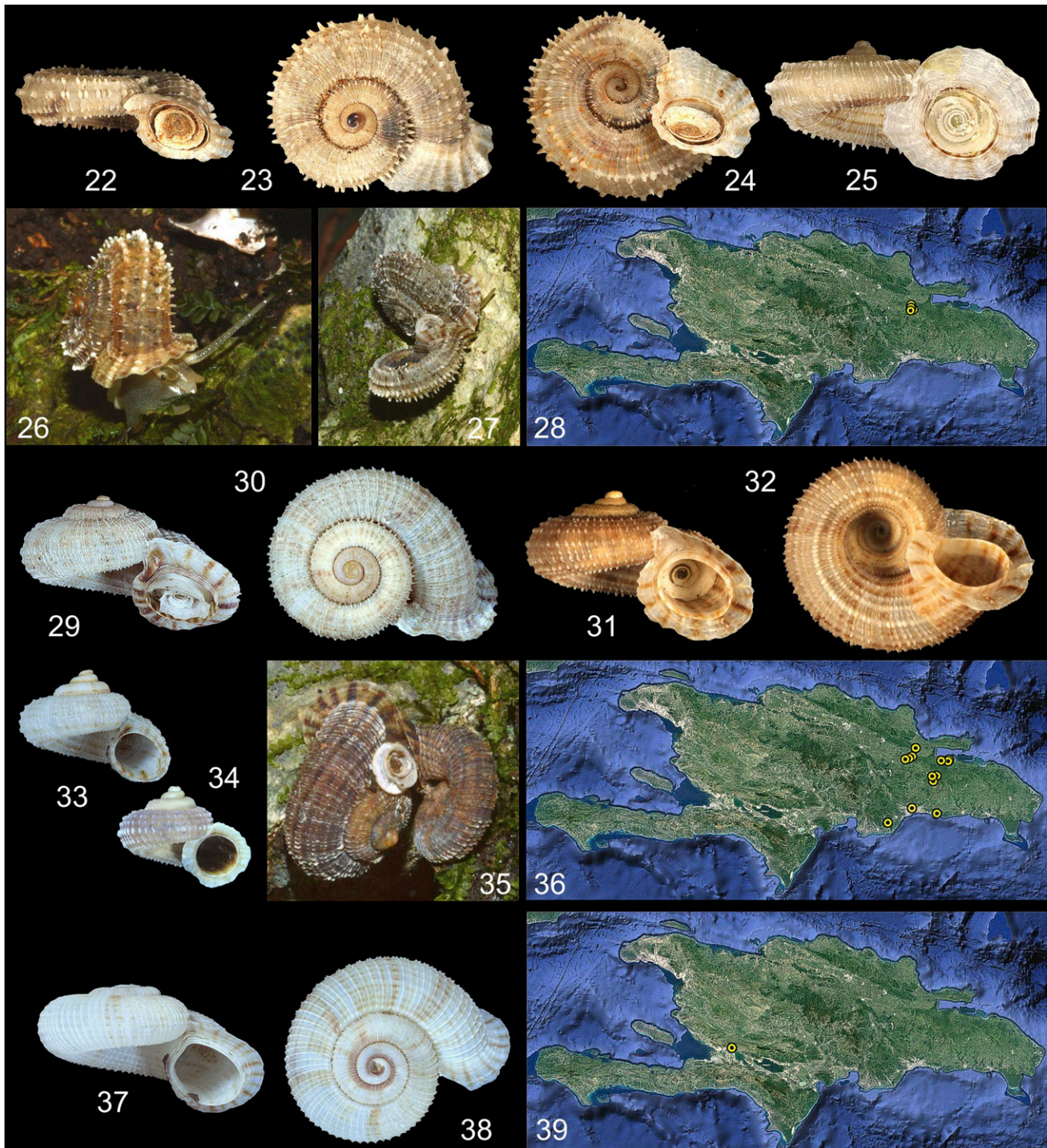
Remarks: This species is a mystery. It occurs so far from other *Abbottella* that it is tempting to believe it was mislocalized. However it was collected by the eminent field naturalist W.L. Abbott. The holotype label reads “1920” and Abbott was known to have collected in Haiti in 1920.

It is also possible this species belongs to a different genus. The pustulose sculpture is rather different from the spinose sculpture of the other *Abbottella*. The species also has some characteristics of *Rolleia*. Do not confuse with the similarly named *Rolleia haitensis* Bartsch, 1946.

Preserved material was not available.

Etymology: William Louis Abbott (1860–1936), American physician, ornithologist, field naturalist, and patron of the United States National Museum, now National Museum of Natural History (USNM).

***Abbottella moreletiana moreletiana* (Crosse, 1873)**
(Figures 18, 40–43, 46)



Figures 22–39. *Abbottella*. **22–28.** *Abbottella crataegus* Watters, 2016. **22–24.** **Holotype**, UF 216138 (12.0 mm diameter). **25.** GTW 16492b (11.0 mm diameter). **26.** Live individual (photo S. Aiken ©). **27.** Mating pair (photo ©S. Aiken). **28.** Distribution map. **29–36.** *Abbottella domingoensis* Bartsch, 1946. **29, 30.** *Abbottella moreletiana domingoensis* Bartsch, 1946. **Holotype**, USNM 504117 (12.2 mm diameter). **31, 32.** UF 216133 (15.2 mm diameter). **33.** *Abbottella moreletiana gabriella* Bartsch, 1946: **Holotype**, USNM 504124 (8.6 mm diameter). **34.** *Abbottella moreletiana wetmorei* Bartsch, 1946: **Holotype**, USNM 504119 (7.0 mm diameter). **35.** Mating pair (photo S. Aiken ©). **36.** Distribution map. **37–39.** *Abbottella haitensis* Bartsch, 1946. **37, 38.** **Holotype**, USNM 504111 (12.7 mm diameter). **39.** Distribution map.

CHRESONYMY

Choanopoma moreletiana Crosse, 1873: 354; Crosse, 1874: 85, pl. 3, figs. 3, 3a; Pilsbry, 1933: 130; Watters, 2006:361.

Choanopoma moreletianum Crosse, 1873: Pfeiffer, 1876: 160–161; Kobelt, 1880: 277; Crosse, 1891: 168.

Tudorae [sic] *moreletianae* [sic] (Crosse, 1873): Arango, 1884: 211.

Abbottella moreletiana (Crosse, 1873): Henderson and Bartsch, 1920: 75; Thiele, 1931: 134; Abbott, 1989: 53; Watters, 2016b: 112, 114, figs. 1–8, 29.

Choanopoma (*Abbottella* [sic]) *moreletianum* Crosse, 1873: Clench and Aguayo, 1937: 67.

Chondropoma moreletianum (Crosse, 1874): Bartsch, 1946: 143.

Abbottella moreletiana moreletiana (Crosse, 1873): Bartsch, 1946: 147, pl. 25, figs. 10–12.

Abbottella (*Abbottella*) *moreletiana moreletiana* (Crosse, 1873): Watters, 2006: 361–362.

Type Material: Holotype: ANSP 14166, not figured in online database; from the Bland collection, collected by Gabb.

Type Locality: “*In regione Dominicanum insulae Haïti, Antillarum.*” Restricted by Watters (2016b) to “Sabana de la Mar, Hato Major Province, Dominican Republic.”

Distribution and Habitat: It occurs on the southern side of Samaná Bay, including the nearshore Lower and Upper Orange keys, from approximately Boca del Infierno to Sabana de la Mar in Samaná and Hato Major provinces in the Los Haitises Limestone. This corresponds to the eastern part of the Cevicos Formation, composed of

karsted, massive limestone blocks of Upper Miocene–Lower Pliocene age (Lebron and Mann, 1991). It is found in mesic forests in association with wet limestone cliffs, where it may be locally abundant. Its range may be <math><100\text{ km}^2</math>.

Etymology: Named after Pierre Marie Arthur Morelet (1809–1892), French naturalist and conchologist working in Central America, Africa, and Europe.

***Abbottella moreletiana kriegeri* Bartsch, 1946**
(Figures 44–46)

CHRESONYMY

Abbottella moreletiana kriegeri Bartsch, 1946: 146, pl. 24, figs. 4–6.

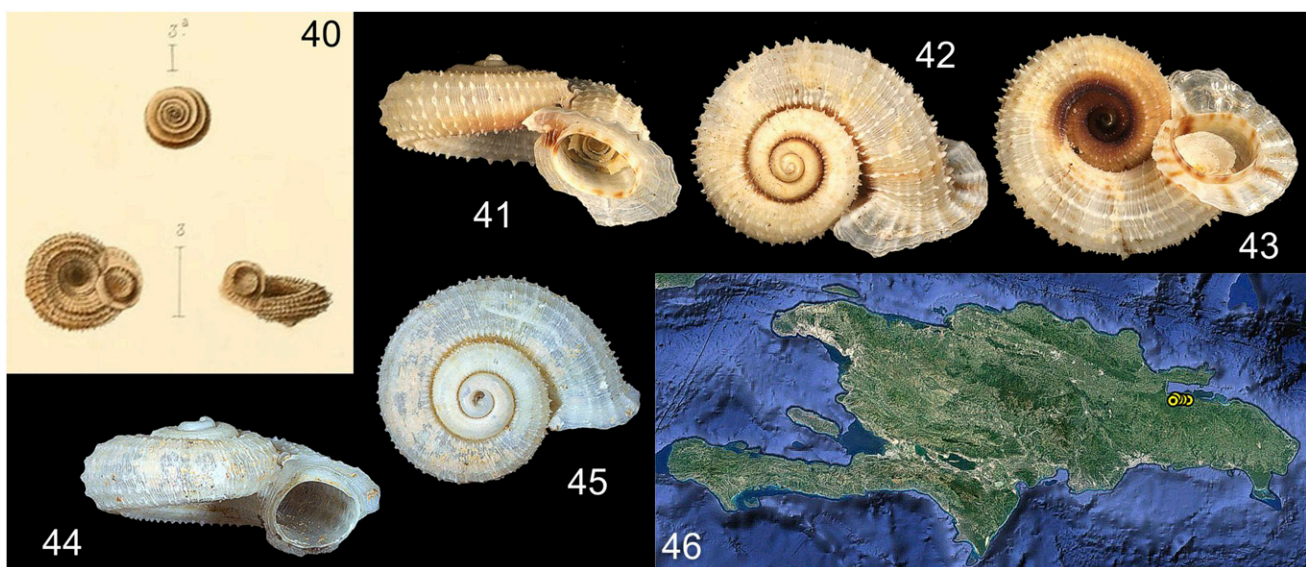
Abbottella (*Abbottella*) *moreletiana kriegeri* Bartsch, 1946: Watters, 2006: 83, 362; Watters, 2016b: 112.

Type Material: Holotype: USNM 504115.

Type Locality: “North side of the Samaná Peninsula on the center of the south side of San Juan Bay, Dominican Republic.” Based on Gabb’s 1873 description and map, this apparently is the bay at Playa de Limón north of El Limón. However, *Abbottella* is not known from the Samaná Peninsula and this locality remains suspicious.

Distribution and Habitat: Known only from the possibly erroneous type locality without habitat information.

Remarks: We suspect this is a stunted form of *A. moreletiana* and the actual provenance is the south side of



Figures 40–46. *Abbottella*. **40–43.** *Abbottella moreletiana moreletiana* (Crosse, 1873). **40.** *Choanopoma moreletiana* Crosse, 1873. Crosse, 1874: 85, pl. 3, figs. 3, 3a. **41–43.** UF 216190 (12.3 mm diameter). **44, 45.** *Abbottella moreletiana kriegeri* Bartsch, 1946. **Holotype**, USNM 504115 (10.0 mm diameter). **46.** Distribution map.

Samaná Bay. Further collections will be needed to verify this. Preserved material was not available.

Etymology: Herbert William Krieger (1889–1970), American anthropologist at the Smithsonian Institution, collector of the type.

Genus *Abbottipoma* new genus

Type Species: *Abbottella abbotti* Bartsch, 1946.

Description: Shell small (ca. 6–10 mm in diameter), turbinoid, with spiral keels and minutely serrated or spiny sculpture, outer lip expanded and/or fimbriated or en-rolled. Operculum as in family.

Distribution: Endemic to the eastern half of the Samaná Peninsula in mesic areas with limestone outcrops (Figure 18).

Etymology: *Abbottella abbotti*, the type species + *-poma*, a standard suffix for many annulariids.

Key to Species

- 1) Sculpture of coarse spines, outer lip deeply fimbriated *abbotti*
- 1) Sculpture of minute serrations, outer lip not deeply fimbriated *abbotti*
- 2) Anterior margin of outer lip en-rolled *gabbi*
- 2) Anterior margin of outer lip not en-rolled *croseii*

Abbottipoma abbotti (Bartsch, 1946)

(Figures 18, 47–54)

CHRESONYMY

Abbottella abbotti Bartsch, 1946: 143, 154–155, pl. 27, figs. 10–12.

Abbottella (Abbottella) abbotti Bartsch, 1946: Watters, 2006: 83, Watters, 2013: 11, figs. 3 A–E, 7 F.

Type Material: Holotype: USNM 504108. The type is a worn specimen that does not show the characteristic spiny sculpture.

Type Locality: “Near Laguna, Samaná Bay” [? Punta Laguna Salada, probable error for Samaná Peninsula, see Watters, 2013].

Distribution and Habitat: This narrowly endemic species occurs in the Sierra de Samaná of the Cordillera Septentrional in the El Valle and the Las Galeras areas on the northeast coast of the peninsula. A record from Cayo Levantado (GTW 10829a) seems unlikely and needs confirmation. Snails live below 50 m elevation on and at the base of limestone walls in cool, shaded areas with

abundant mosses and other vegetation. It may occur in <10 km². At El Valle it lives within a few hundred meters of the beach in association with *Lagopoma lagopoma*, *Helicina salleana* Pfeiffer, 1852, and the very large pleurodontid *Caracolus excellens* (Pfeiffer, 1853).

Remarks: This species has been observed suspending itself by a mucus thread(s) from limestone outcrops.

Etymology: William Louis Abbott (1860–1936), American physician, ornithologist, field naturalist, and patron of the United States National Museum, now National Museum of Natural History (USNM).

Abbottipoma croseii (Pilsbry, 1933)

(Figures 18, 55–62)

CHRESONYMY

Choanopoma croseii Pilsbry, 1933: 130, pl. 7, figs. 5, 5a, 6. *Abbottella croseii* (Pilsbry, 1933): Bartsch, 1946: 144, 153, pl. 27, figs. 13–15.

Abbottella gabbi pilsbryi Bartsch, 1946: 152–153, pl. 27, figs. 7–9.

Rolleia croseii (Pilsbry, 1933): Baker, 1964: 169.

Abbottella (Abbottella) croseii (Pilsbry, 1933): Watters, 2006: 83, 222; Watters and Duffy, 2010a: 2; Watters, 2013: 14, figs. 3 S–W, 7 G.

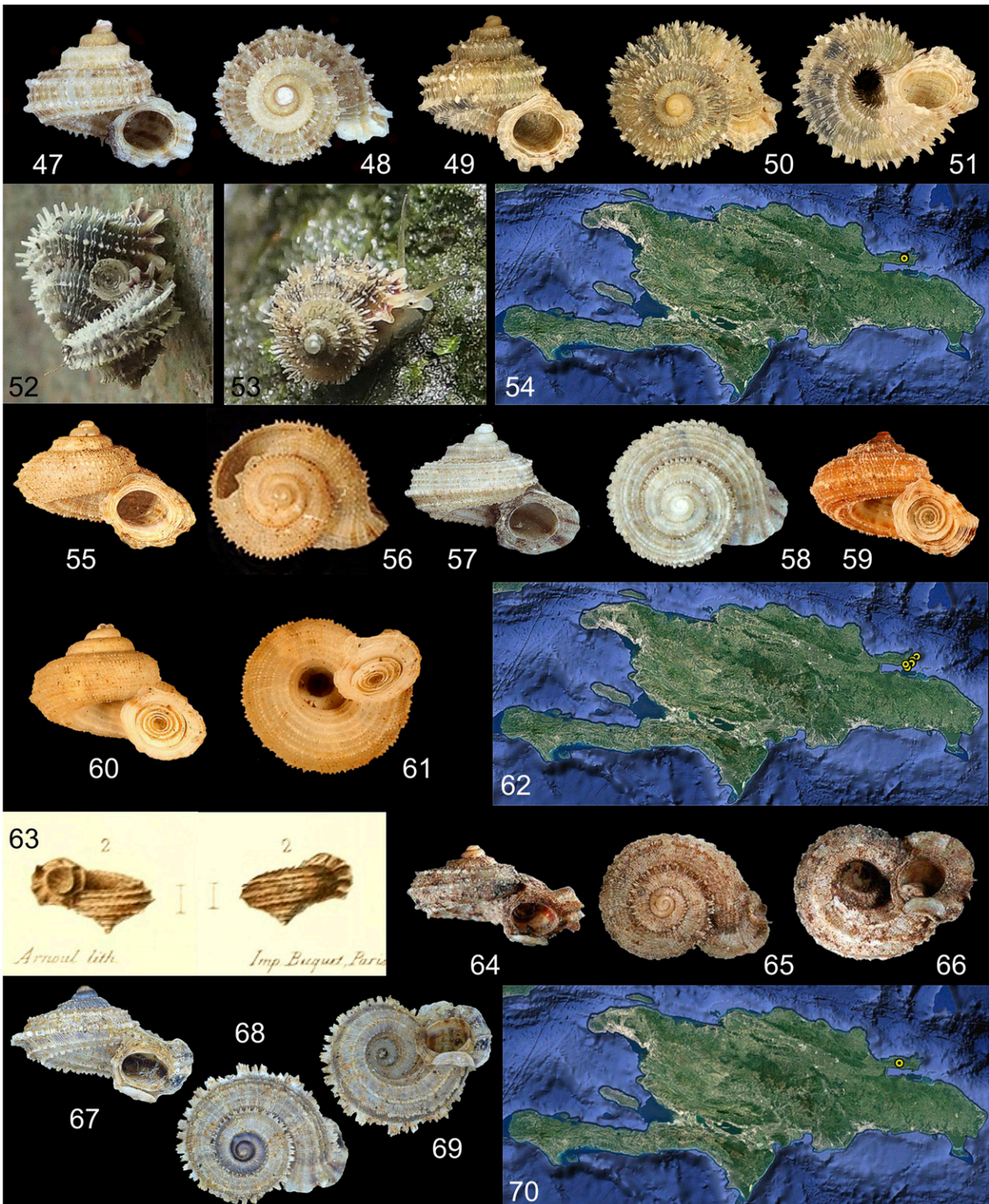
Abbottella (Abbottella) gabbi pilsbryi Bartsch, 1946: Watters, 2006: 83, 269.

? *Abbottella (Abbottella) harpeza* Watters and Duffy, 2010a: 1–2, figs. 1–3.

Type Material: *Choanopoma croseii* Pilsbry, 1933: Holotype: ANSP 7951; Paratype: ANSP 373769(1). The type lot of *A. gabbi* contained two species, *gabbi* and *croseii*. Pilsbry (1933) designated Crosse’s figured specimen of the lot as the type of *A. gabbi*. *Abbottella gabbi pilsbryi* Bartsch, 1946: Holotype: USNM 504099. *Abbottella harpeza* Watters and Duffy, 2010: Holotype: UF 420731.

Type Locality: *Choanopoma croseii* Pilsbry, 1933: “Santo Domingo.” Restricted by Watters (2013) to “4 km E of Samaná, Samaná Province, Dominican Republic.” *Abbottella gabbi pilsbryi* Bartsch, 1946: “in a cave on the Río Seco near Samaná, Samaná Bay, Dominican Republic.” *Abbottella harpeza* Watters and Duffy, 2010: “Isla Beata,” probably in error for Samaná Peninsula.

Distribution and Habitat: This species inhabits the coastal limestone bluffs of the eastern Samaná Peninsula in the Sierra de Samaná including Cayo Levantado. Specimens have been found on limestone outcrops in fields and on cliffs and stone walls, often abundant; occasionally arboreal. All specimens seen were found below 50 m elevation.



Figures 47–70. *Abbottipoma*. **47–54.** *Abbottipoma abbotti* (Bartsch, 1946). **47, 48.** **Holotype**, USNM 504108 (6.0 mm diameter). **49–51.** GTW 10829b (7.1 mm diameter). **52.** Mating pair. **53.** Live individual. **54.** Distribution map. **55–62.** *Abbottipoma crossei* (Pilsbry, 1933). **55, 56.** *Choanopoma crossei* Pilsbry, 1933. **Holotype**, ANSP 7951 (7.5 mm diameter, photo courtesy of ANSP). **57, 58.** *Abbottella gabbi pilsbryi* Bartsch, 1946. **Holotype**, USNM 504099 (7.5 mm diameter). **59.** *Abbottella (Abbottella) harpeza* Watters and Duffy, 2010. **Holotype**, UF 420731 (7.1 mm diameter). **60, 61.** GTW 9432a (7.3 mm diameter). **62.** Distribution map. **63–70.** *Abbottipoma gabbi* (Crosse, 1873). **63.** *Choanopoma gabbi* Crosse, 1873. Crosse, 1874: 84, pl. 3, fig. 2. **64–66.** **Syntype**, MNHN 2000-5452 (7.4 mm diameter, photo courtesy of Manuel Caballer, MNHN). **67–69.** Julian Joseph coll. (6.3 mm diameter, photos ©S. Aiken). **70.** Distribution map.

Remarks: *Abbottella harpeza* Watters and Duffy, 2010, was described from Isla Beata. This now seems very unlikely, being far out of the range of all other abbottellines, and probably represents a mislocalized specimen. Additional study at Isla Beata is needed to confirm this.

Etymology: *Choanopoma crossei* Pilsbry, 1933: Joseph Charles Hippolyte Crosse (1826–1898), French conchologist, editor of the *Journal de Conchyliologie*. *Abbottella gabbi pilsbryi* Bartsch, 1946: Henry Augustus Pilsbry (1862–1957), American conchologist, Academy of Natural Sciences of Philadelphia. *Abbottella harpeza* Watters and Duffy, 2010: *L. harpeza*, a thorny bush, a thicket.

***Abbottipoma gabbi* (Crosse, 1873)**
(Figures 18, 63–70)

CHRESOONYMY

Choanopoma gabbi Crosse, 1873: 353–354; Crosse, 1874: 84, pl. 3, fig. 2; Pfeiffer, 1876: 159; Kobelt, 1880: 277; Crosse, 1891: 168; Henderson and Bartsch, 1920: 75; Pilsbry, 1933: 129–130, pl. 7, figs. 1–4; Fischer-Piette, 1950: 80.

Abbottella gabbi (Crosse, 1873): Henderson and Bartsch, 1920: 75.

Abbottella gabbi gabbi (Crosse, 1873): Bartsch, 1946: 144, 152, pl. 26, figs. 5–7.

Abbottella (*Abbottella*) *gabbi gabbi* (Crosse, 1873): Watters, 2006: 83, 269.

Type Material: Syntype: MNHN 2000-5452 (Only one specimen mentioned in database, number of additional specimens unknown). This specimen is a worn example.

Type Locality: “in regione Dominicanum insulae Haïti, Antillarum.” Restricted here to “near El Salto del Limón, central Samaná Peninsula, Samaná Province, Dominican Republic.”

Distribution and Habitat: This unlocalized species was recently rediscovered after nearly 150 years at El Salto del Limón in the central Samaná Peninsula. It was found in “soil/leaf litter around coral/limestone boulders along the edge of the forest path” to the waterfall (J. Joseph, 2017, pers. comm.).

Remarks: The combination of the enrolled anterior portion of the outer lip, purple apex, and strong, spiral, fimbriated carinations is unique. Preserved material was not available.

Etymology: William More Gabb (1839–1878), American geologist and paleontologist who surveyed in Hispaniola.

Genus *Arenabbottella* new genus

Type Species: *Abbottella sosuaensis* Bartsch, 1946.

Description: Shells small (6–11 mm in diameter), turbinoid, sculpture of minute pustules or weak serrations on more-or-less well-developed spiral cords often forming weak keels, cords often prominent in umbilicus, suture channeled, outer lip expanded, often auriculate. Lip may be folded or rolled abaperturally to varying degrees. Sculpture is often arranged in axial “blocks” probably representing growth lines.

Distribution: This is the most widely distributed abbottelline group, occurring around the eastern half of the island on the northern slopes of the Cordillera Septentrional from Luperon to the Samaná Peninsula and around the southeastern lowlands from Las Lagunas de Nisibon to San Cristobal, including Isla Saona (Figure 19). Snails live under leaf litter and limestone rubble, from open fields to mesic forests.

Remarks: This is the most speciose of the Hispaniolan abbottelline genera. Based on conchological features and distributional patterns, there seems to be a split below Samaná Bay between a northern and a southern group of species but none of the northern species were available for phylogenetic study. These two groups may yet be found to constitute different genera.

Etymology: *L. arenosus*, full of sand + *Abbottella*; in reference to the sandy sculpture of the shells.

Key to Species

The questionable taxa *Choanopoma adolfi* Pfeiffer, 1852, and *Cyclostoma tentorium* Pfeiffer, 1850, are not included.

- 1) Columellar side of outer lip enrolled . . . *samanaensis*
- 1) Columellar side of outer lip not enrolled 2
- 2) Outer lip fimbriated *rosaliae*
- 2) Outer lip not fimbriated 3
- 3) Shell with a prominent central, serrated keel
- *calliotropis*
- 3) Shell without a prominent keel 4
- 4) Outer lip narrowly expanded 5
- 4) Outer lip widely expanded 8
- 5) Sculpture nearly obsolete, shell with a metallic sheen *nitens*
- 5) Sculpture not as above 6
- 6) Final whorl with ca. 120 axial lamellae, shell usually white *milleacantha*
- 6) Final whorl with <100 axial lamellae, shell usually copper-colored 7

- 7) Final whorl with ca. 90 axial lamellae, eastern *aenea*
 7) Final whorl with ca. 70 axial lamellae, western *urbana*
 8) Sculpture nearly obsolete except for umbilicus, shells rather smooth 9
 8) Sculpture of minute but well-developed serrations 11
 9) Strong spiral cords absent from umbilicus *tenebrosa*
 9) Strong spiral cords present in umbilicus 10
 10) Shell pale yellow with brown spots, suture with white, random denticles *mellosa*
 10) Shell brown without spots, suture lacking white, random denticles *newcombi*
 11) Strong spiral cords absent from umbilicus 12
 11) Strong spiral cords present in umbilicus 13
 12) Shell pale brown or yellow, sculpture fine *wilhelmi*
 12) Shell dark brown or white, sculpture coarse *dichroa*
 13) Spiral cords not all of uniform strength, outer lip widely expanded *anchezi*
 13) Spiral cords approximately the same strength, outer lip narrowly expanded *sosuaensis*

Arenabbottella adolfi (Pfeiffer, 1852)

(Figures 19, 71, 72)

CHRESOONYMY

- Choanopoma adolfi* Pfeiffer, 1852a: 167; Pfeiffer, 1853: 117–118; Adams and Adams, 1856: 296; Hjalmarson and Pfeiffer, 1858: 139; Pfeiffer, 1858b: 102; Kobelt, 1880: 277; Crosse, 1891: 166.
Cyclostoma (Choanopoma) adolfi (Pfeiffer, 1852): Pfeiffer, 1854a: 142.
Cyclostoma adolfi (Pfeiffer, 1852): Pfeiffer, 1854c: pl. 48, figs. 5–8; Pfeiffer, 1854d: 371.
Choanopoma adolphi [*sic*] Pfeiffer, 1852: Bland, 1861: 355; Pfeiffer, 1865: 111; Pfeiffer, 1876: 161.
Cyclostoma adolphi [*sic*] (Pfeiffer, 1852): Reeve, 1862: pl. 22, fig. 146.
Abbottella adolphi [*sic*] (Pfeiffer, 1852): Henderson and Bartsch, 1920: 75.
Abbottella adolphi adolphi [*sic*] (Pfeiffer, 1852): Bartsch, 1946: 143, 149–150, pl. 26, fig. 4.
Abbottella (Abbottella) adolfi adolfi (Pfeiffer, 1852): Watters, 2006: 83, 130.
Abbottella adolfi (Pfeiffer, 1852): Watters and Duffy, 2010a: 2.
non Abbottella (Abbottella) cf. adolfi adolfi (Pfeiffer, 1852): Watters, 2013: 13, figs. 3 F–I, 9 D [= *A. mellosa*].

Type Material: The type has apparently been lost. Many of Pfeiffer's types were probably destroyed by Allied

bombing of the Museum Narodone in Szczecin, Poland, in WW II.

Type Locality: “*Habitat in insula Haiti.*”

Distribution and Habitat: Known only from the unlocalized type locality without habitat information.

Remarks: Pfeiffer (1854: pl. 48, figs. 5–8) and Reeve (1862: pl. 22, fig. 146) illustrated it but it cannot be confidently identified from these figures. It is here considered a *nomen dubium*.

Etymology: Probably Emil Adolf Rossmässler (1805[?]–1867), German conchologist.

Arenabbottella aenea (Watters, 2010)

(Figures 19, 76–79)

CHRESOONYMY

Abbottella (Abbottella) aenea Watters, 2010: 16–17, text fig., pl. 1, figs. 1–4; Watters, 2013: 13, figs. 3 N–R, 8 C.

Type Material: Holotype: UF 434777; Paratype: UF 434778(1); Paratypes: BMSM 17971(2); Paratypes: OSUM 35490(2), all from the type locality.

Type Locality: “Dominican Republic, La Altagracia Province, Punta Cana.”

Distribution and Habitat: Known only from the type locality. Specimens were found under moldy leaf litter.

Remarks: Preserved material was not available.

Etymology: *L. aeneus*, copper.

Arenabbottella calliotropis (Watters, 2013)

(Figures 19, 80–83)

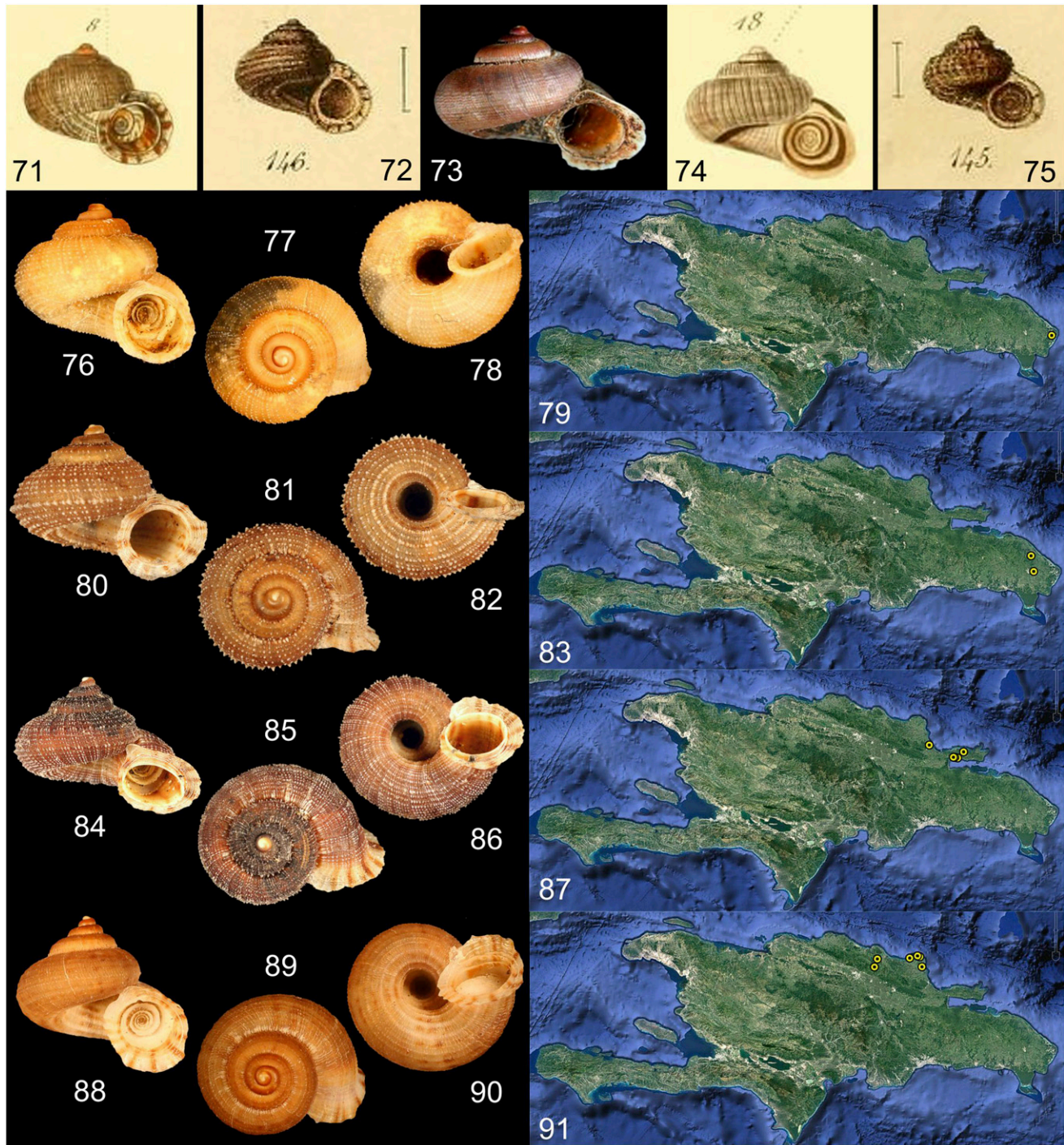
CHRESOONYMY

Abbottella (Abbottella) calliotropis Watters, 2013: 3, figs. 1 A–E, 5 O, 7 A.

Type Material: Holotype: UF 456810; Paratypes: UF 216131(59), from the type locality.

Type Locality: “Dominican Republic, La Altagracia Province, along Río Yuna, 2 km S of La Guana. ca. 18.79° N, – 68.67° W.”

Distribution and Habitat: Under limestone rubble in fields on the easternmost outcrops of the cordillera in La Altagracia Province in the area of Higüey and Las Lagunas de Nisibon.



Figures 71–91. *Arenabbottella*. **71, 72.** *Arenabbottella adolfi* (Pfeiffer, 1852). **71.** *Choanopoma adolfi* Pfeiffer, 1852. Pfeiffer, 1854c: pl. 48, fig. 8. **72.** *Cyclostoma adolfi* [sic] (Pfeiffer, 1852); Reeve, 1862: pl. 22, fig. 146. **73.** *Arenabbottella newcombi* (Crosse, 1873). **Syntype**, MNHN 5436 (photo courtesy of MNHN). **74, 75.** *Arenabbottella tentorium* (Pfeiffer, 1850). **74.** *Cyclostoma tentorium* Pfeiffer, 1850. Pfeiffer, 1854b: pl. 38, fig. 18. **75.** *Cyclostoma tentorium* Pfeiffer, 1850. Reeve, 1862: pl. 22, fig. 145. **76–79.** *Arenabbottella aenea* (Watters, 2010). **76–78.** GTW 14181a (6.5 mm diameter). **79.** Distribution map. **80–83.** *Arenabbottella calliotropis* (Watters, 2013). **80–82.** **Holotype**, UF 456810 (7.5 mm diameter). **83.** Distribution map. **84–87.** *Arenabbottella dichroa* (Watters, 2013). **84–86.** **Holotype**, UF 456801 (9.9 mm diameter). **87.** Distribution map. **88–91.** *Arenabbottella mellosa* (Watters and Duffy, 2010). **88–90.** GTW 7020c (5.0 mm diameter). **91.** Distribution map.

Remarks: Preserved material was not available.

Etymology: Gr. *kallos*, beauty + Gr. *trope*, a turning.

***Arenabbottella dichroa* (Watters, 2013)**

(Figures 19, 84–87)

CHRESOONYMY

Abbottella (*Abbottella*) *dichroa* Watters, 2013: 6–7, figs. 1 K–O, 5 Q, 7 C.

Type Material: Holotype: UF 456801; Paratypes: UF 216112(31), from the type locality.

Type Locality: “Dominican Republic, Samaná Province, just E of El Limón, 10 km E of Las Terrenas, at sea level. ca. 19.29° N, –69.44° W.”

Distribution and Habitat: Known from the north coast of the Sierra de Samaná of the Cordillera Septentrional from the western Samaná Peninsula to Nagua on limestone hills in mesic, shaded forests.

Remarks: This species is peculiar in having two color morphs in the same population: white or brown. This may be due to sexual dimorphism. Preserved material was not available.

Etymology: Gr. *di-*, two + Gr. *chroa*, color of the skin; in reference to the two color morphs.

***Arenabbottella mellosa* (Watters and Duffy, 2010)**

(Figures 19, 88–91)

CHRESOONYMY

Abbottella (*Abbottella*) *mellosa* Watters and Duffy, 2010a: 2, figs. 4–6; Watters, 2013: 8, fig. 1 T.

Abbottella (*Abbottella*) cf. *adolphi adolphi* (Pfeiffer, 1852): Watters, 2013: 13, figs. 3 F–I, 9 D.

Type Material: Holotype: UF 420729; Paratype: OSUM 32477(1), from the type locality.

Type Locality: “Dominican Republic, Los Brazos, near Sosúa.”

Distribution and Habitat: Known only from three adjacent outcrops: Loma Catalina and Loma Blanca near Sosúa and the outcrop near Río San Juan on the northern coast. All specimens seen were found below 70 m elevation.

Remarks: Rare, well-preserved specimens have periotracal hairs.

Etymology: L. *mellosa*, honey-colored.

***Arenabbottella milleacantha* (Watters and Duffy, 2010)**

(Figures 19, 92–95)

CHRESOONYMY

Abbottella (*Abbottella*) *milleacantha* Watters and Duffy, 2010a: 2–3, figs. 7–9; Watters, 2013: 4, 7, 13, 14, figs. 3 X–BB, 7 H.

Type Material: Holotype: UF 420728; Paratype: OSUM 32478(1), from the type locality.

Type Locality: “Dominican Republic, northeast Isla Saona.”

Distribution and Habitat: This species occurs on Isla Saona and the adjacent coast from San Pedro de Macoris to Bavaro in sub-mesic to mesic forests along limestone ridges under blocks and in leaf litter; also in caves.

Remarks: Preserved material was not available.

Etymology: L. *mille*, thousand + Gr. *akantha*, thorn, prickle.

***Arenabbottella newcombi* (Crosse, 1873)**

(Figure 73)

CHRESOONYMY

Choanopoma newcombi Crosse, 1873: 352–353; Crosse, 1874: 82, pl. 3, figs. 1, 1a; Pfeiffer, 1876: 160; Kobelt, 1880: 277; Crosse, 1891: 167–168; Fischer-Piette, 1950: 79–80.

Abbottella newcombi (Crosse, 1873): Henderson and Bartsch, 1920: 75; Bartsch, 1946: 143, 144–145, pl. 24, figs. 7–9.

Abbottella (*Abbottella*) *newcombi* (Crosse, 1873): Watters, 2006: 83, 371; Watters, 2013: 13.

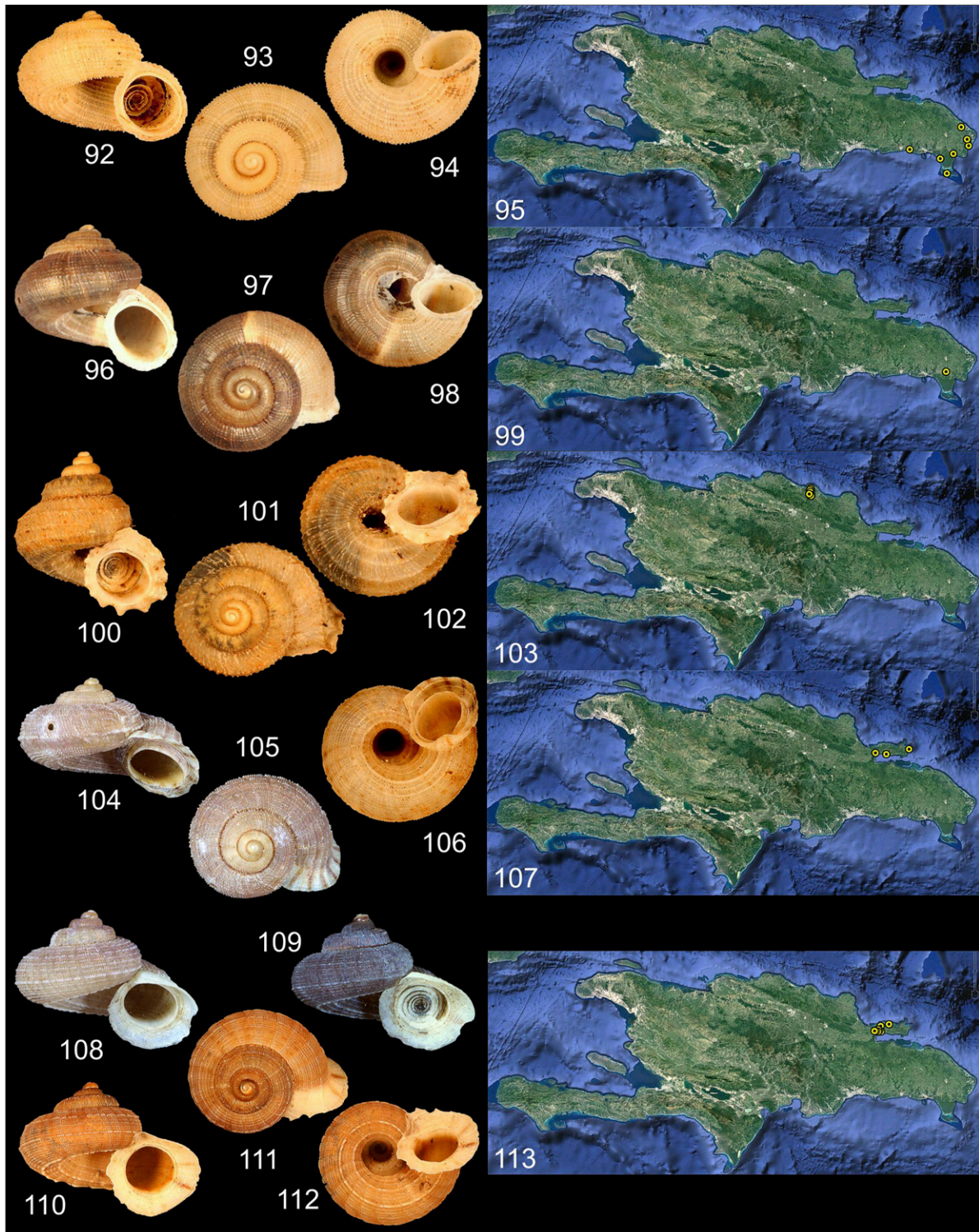
Type Material: Syntype: MNHN 5436.

Type Locality: “in regione Dominicanum insulae Haïti, Antillarum.”

Distribution and Habitat: Known only from the unlocalized type locality.

Comparison with Other Species: Based on two specimens, this is a relatively smooth, brown shell with a deep suture and lacking keels.

Remarks: Bartsch’s (1946) specimens were received from Newcomb but with only “Santo Domingo” as their provenance, undoubtedly referring to the country rather than the city. Although clearly a member of this group it has not been collected since its description.



Figures 92–113. *Arenabbottella*. **92–95.** *Arenabbottella milleacantha* (Watters and Duffy, 2010). **92–94.** **Holotype**, UF 420728 (7.5 mm diameter). **95.** Distribution map. **96–99.** *Arenabbottella nitens* (Watters, 2013). **96–98.** **Holotype**, UF 456806 (7.8 mm diameter). **99.** Distribution map. **100–103.** *Arenabbottella rosaliae* (Pfeiffer, 1858). **100–102.** UF 216191 (9.2 mm diameter). **103.** Distribution map. **104–107.** *Arenabbottella samanensis* (Bartsch, 1956). **104, 105.** **Holotype**, USNM 504090 (10.6 mm diameter). **106.** GTW 7085c (8.7 mm diameter). **107.** Distribution map. **108–113.** *Arenabbottella sanchezi* (Bartsch, 1946). **108.** *Abbottella sanchezi* Bartsch, 1946. **Holotype**, USNM 504092 (9.1 mm diameter). **109.** *Abbottella adolphi peninsularis* Bartsch, 1946. **Holotype**, USNM 504095 (9.8 mm diameter). **110–112.** UF 216154 (9.1 mm diameter). **113.** Distribution map.

Etymology: Wesley Newcomb (1808–1892), American physician, conchologist, Hawaiian temperance leader.

***Arenabbottella nitens* (Watters, 2013)**

(Figures 19, 96–99)

CHRESOONYMY

Abbottella (*Abbottella*) *nitens* Watters, 2013: 7, figs. 1 P–S, 5 R, S, 8 A.

Type Material: Holotype: UF 456806; Paratypes: UF 456808(15), from the type locality.

Type Locality: “Dominican Republic, La Altagracia Province, 16 km S of Higüey, at 100 m. ca. 18.46° N, – 68.71° W.”

Distribution and Habitat: Known only from the type locality under rocks among boulders, on a limestone bluff west of Highway 4.

Remarks: Preserved material was not available.

Etymology: L. *niteo*, shine, glitter, in reference to the metallic sheen of most specimens.

***Arenabbottella rosaliae* (Pfeiffer, 1858)**

(Figures 15, 19, 100–103)

CHRESOONYMY

Choanopoma rosaliae Pfeiffer in Hjalmarsen and Pfeiffer, 1858: 139–140, pl. 2, figs. 4–6; Bland, 1861: 355; Pfeiffer, 1865: 111; Pfeiffer, 1876: 161; Kobelt, 1880: 277; Crosse, 1891: 166; Pilsbry, 1933: 130.

Abbottella rosaliae (Pfeiffer, 1858): Henderson and Bartsch, 1920: 75; Bartsch, 1946: 144, 155, pl. 27, figs. 4–6.

Abbottella (*Abbottella*) *rosaliae* (Pfeiffer, 1858): Watters, 2006: 83, 447; Watters, 2013: 14–16, figs. 4 A–E, 9 A.

Type Material: Not located, presumed lost.

Type Locality: “*In insulae Haiti*.” Restricted by Watters (2013) to “Dominican Republic, Puerto Plata Province, Loma Catalina.”

Distribution and Habitat: This species is known only from Loma Catalina, an outcrop of the Cordillera Septentrional southeast of Sosúa, occurring in ca. 100 km². Much of this area is contained in the Parque Nacional El Choco. All specimens seen were found between 30–280 m elevation on limestone bluffs.

Remarks: This species possesses a periostracum although it is lost in most specimens. On fresh examples this periostracum forms short bristles at the junctures of the

axial and spiral sculptures. In general, a periostracum appears to be very rare in the Annulariidae.

Etymology: Unknown, the identity of Rosalie has been lost to time.

***Arenabbottella samanensis* (Bartsch, 1946)**

(Figures 19, 104–107)

CHRESOONYMY

Abbottella samanensis Bartsch, 1946: 143, 148–149, pl. 25, figs. 7–9.

Abbottella (*Abbottella*) *samanensis* Bartsch, 1946: Watters, 2006: 83, 460; Watters, 2013: 16, figs. 4 F–I, 9 B.

Type Material: Holotype: USNM 504090.

Type Locality: “Cape Samaná, Dominican Republic.”

Distribution and Habitat: Samaná Peninsula in the Sierra de Samaná of the Cordillera Septentrional. Live snails have been found in leaf litter.

Remarks: Preserved material was not available.

Etymology: From the Samaná Peninsula.

***Arenabbottella sanchezi* (Bartsch, 1946)**

(Figures 19, 108–113)

CHRESOONYMY

Abbottella sanchezi Bartsch, 1946: 143, 149, pl. 26, figs. 1–3.

Abbottella adolphi [*sic*] *peninsularis* Bartsch, 1946: 150–151, pl. 26, figs. 14–16.

Abbottella (*Abbottella*) *adolphi peninsularis* Bartsch, 1946: Watters, 2006: 83, 130; Watters, 2013: 6, 13, figs. 3 J–L, 8 H.

Abbottella (*Abbottella*) *sanchezi* Bartsch, 1946: Watters, 2006: 83, 460; Watters, 2013: 6, 8, 13, 16, 17, figs. 4 J–N, 8 C.

Type Material: *Abbottella sanchezi* Bartsch, 1946: Holotype: USNM 504092. *Abbottella adolphi peninsularis* Bartsch, 1946: Holotype: USNM 504095.

Type Locality: *Abbottella sanchezi* Bartsch, 1946: “2 miles northwest of Sánchez, Dominican Republic.”

Abbottella adolphi peninsularis Bartsch, 1946: “On the trail from Samaná to Río San Juan, Samaná Peninsula.”

Distribution and Habitat: The species is found in the Sierra de Samaná from at least Sánchez to Los Cacaos in the south and Las Terrenas in the north. Found in association with limestone boulders, leaf litter, and talus in mesic forests and near caves. All specimens seen were found below 320 m elevation.

Remarks: Bartsch (1946) differentiated *A. sanchezi* and *A. a. peninsularis* based on differences in spire height. Both fall within the range of variation of a single species. This species may exhibit color dimorphism, probably sexual. *Abbottella sanchezi* is here chosen as the valid name for the taxon.

Etymology: *Abbottella sanchezi* Bartsch, 1946: from Sánchez, Dominican Republic. *Abbottella adolphi peninsularis* Bartsch, 1946: from the Samaná Peninsula.

***Arenabbottella sosuaensis* (Bartsch, 1946)**
(Figures 19, 114–117)

CHRESONOMY

Abbottella sosuaensis Bartsch, 1946: 143, 151, pl. 26, figs. 11–13.

Abbottella (Abbottella) sosuaensis Bartsch, 1946: Watters, 2006: 83, 489–490; Watters, 2010: 17; Watters, 2013: 6, 17, 18, figs. 4 O–S, 9 E.

Type Material: Holotype: USNM 336768.

Type Locality: “Sosúa, 16 miles east of Puerto Plata, Dominican Republic.”

Distribution and Habitat: This species is found on the northern slopes of the Cordillera Septentrional from Luperon to Río San Juan under rocks along rolling limestone hills, pastures, and under limestone rubble at the base of cliffs; it may be locally common. It does not occur at El Valle as reported by Watters (2013). All specimens seen were found below 100 m elevation.

Etymology: From Sosúa, Dominican Republic.

***Arenabbottella tenebrosa* (Watters, 2013)**
(Figures 19, 118–121)

CHRESONOMY

Abbottella (Abbottella) tenebrosa Watters, 2013: 6, 8, figs. 1 U–Y, 8 B.

Type Material: Holotype: UF 456796; Paratypes: UF 456797(15); Paratypes: OSUM 37271(12); Paratypes: BMSM 17937(16), all from the type locality.

Type Locality: “Dominican Republic, Puerto Plata Province, El Choco, near Cabarete. ca. 19.74° N, –70.42° W.”

Distribution and Habitat: This species is found from the limestone outcrops of El Choco near Cabarete to just west of Río San Juan. All specimens seen were found below 20 m elevation.

Etymology: *L. tenebrosus*, dark, gloomy, in reference to the shell color.

?*Arenabbottella tentorium* (Pfeiffer, 1850)
(Figures 74, 75)

CHRESONOMY

Cyclostoma tentorium Pfeiffer, 1850: 77; Pfeiffer, 1854b: 284, pl. 38, figs. 16–18; Reeve, 1862: pl. 22, fig. 145.

Choanopoma tentorium (Pfeiffer, 1850): Pfeiffer, 1851: 155; Pfeiffer, 1852a: 168; Pfeiffer, 1852b: 27; Pfeiffer, 1853: 118; Adams and Adams, 1856: 296; Pfeiffer, 1858b: 102; Bland, 1861: 355; Pfeiffer, 1865: 111; Pfeiffer, 1876: 161; Kobelt, 1880: 277; Crosse, 1891: 167.

Abbottella (Abbottella) tentorium (Pfeiffer, 1850): Watters, 2006: 83, 505.

non Abbottella tentorium (Pfeiffer, 1850): Henderson and Bartsch, 1920: 75; Bartsch, 1946: 144, 153, pl. 27, figs. 1–3 [= ?*A. wetmorei*].

Type Material: Not located, presumed lost.

Type Locality: “in insula Haiti.”

Remarks: Pfeiffer’s 1850 description of “*Interdum rubro-punctata*” does not conform to any known *Abbottella*. Reeve’s 1862 figure seems to show this feature more so than does Pfeiffer’s 1854 figure. At 6.5 mm in diameter only *M. diadema* and *A. urbana* are smaller. Bartsch’s 1946 specimen (his pl. 27, figs. 1–3) from an unknown locality does not seem to be the same species and lacks any red spots; it appears to be a pale specimen of *A. wetmorei*. This may possibly be an earlier name for *A. urbana*.

Etymology: *L. tentorium*, a tent, a noun in apposition.

***Arenabbottella urbana* (Watters, 2012)**
(Figures 19, 122–128)

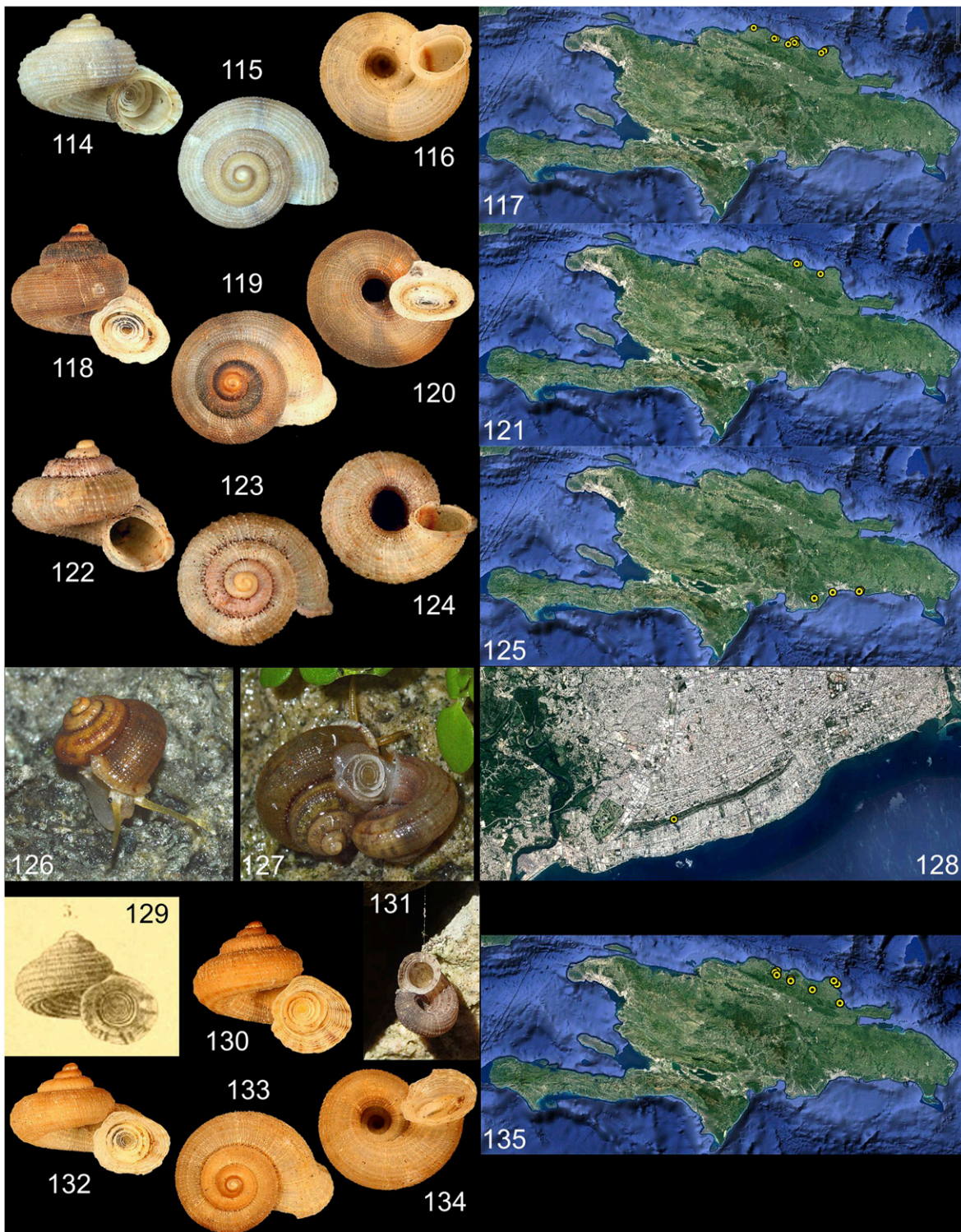
CHRESONOMY

Abbottella (Abbottella) urbana Watters, 2012: 1, 3, figs. 1–3; Watters, 2016: 115–166.

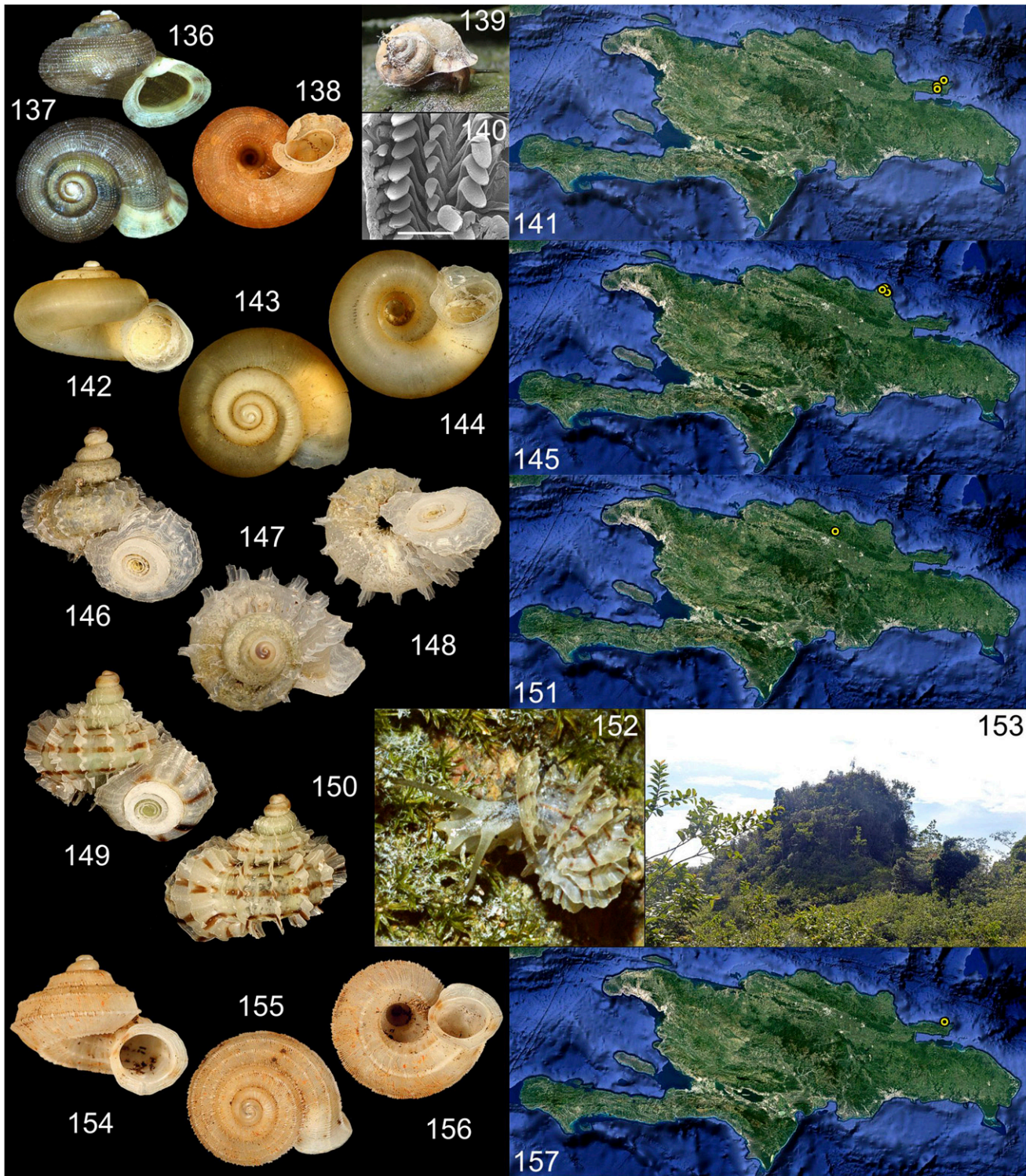
Type Material: Holotype: UF 446061; Paratype: OSUM 36509(1), from the ttype locality.

Type Locality: “Parque Central, off José Contreras Blvd., N of the Loteria barrio of western Santo Domingo, Distrito Nacional, Dominican Republic, 18.44 N, –69.97 W.”

Distribution and Habitat: Known from Parque Central/Parque Mirador del Sur in downtown Santo Domingo



Figures 114–135. *Arenabbottella*. **114–117.** *Arenabbottella sosuaensis* (Bartsch, 1946). **114, 115.** Holotype, USNM 336768 (7.0 mm diameter). **116.** UF 218136 (6.9 mm diameter). **117.** Distribution map. **118–121.** *Arenabbottella tenebrosa* (Watters, 2013). **118–120.** Holotype, UF 456796 (8.9 mm diameter). **121.** Distribution map. **122–128.** *Arenabbottella urbana* (Watters, 2012). **122–124.** Holotype, UF 446061 (4.9 mm diameter). **125.** Distribution map. **126.** Live individual (photos ©S. Aiken). **127.** Mating pair (photos ©S. Aiken). **128.** Type locality in Parque Central in Santo Domingo. **129–135.** *Arenabbottella wilhelmi* (Pfeiffer, 1858). **129.** *Choanopoma wilhelmi* Pfeiffer in Hjalmarson and Pfeiffer, 1858: pl. 2, fig. 3. **130.** UF 216150 (8.0 mm diameter). **131.** Live individual suspended from mucus thread. **132–134.** UF 216150 (8.5 mm diameter). **135.** Distribution map.



Figures 136–157. *Lagopoma*, *Leiabbottella*, *Meganiphe*, *Microabbottella*. **136–141.** *Lagopoma lagopoma* Bartsch, 1946. **136–137.** **Holotype**, USNM 356198 (5.0 mm diameter). **138.** GTW 10081a (9.7 mm diameter). **139.** Live individual. **140.** Radula (bar=100 μ). **141.** Distribution map. **142–145.** *Leiabbottella galaxius* Watters, 2010. **142–144.** **Paratype**, OSUM 35491 (8.4 mm diameter). **145.** Distribution map. **146–153.** *Meganiphe rhecta* Thompson, 1978. **146–148.** **Paratype**, GTW 8227a (10.6 mm diameter). **149–150.** GTW 11371b (8.0 mm diameter). **151.** Distribution map. **152.** Live individual (photo ©S. Aiken). **153.** Habitat (photo ©S. Aiken). **154–157.** *Microabbottella diadema* (Watters, 2013). **154–156.** **Holotype**, UF 456814 (6.0 mm diameter). **157.** Distribution map.

(Figure 128), among vacant lots in Boca Chica to the east, and almost to Peravia Province to the west. It is likely that this species historically occurred along the southern extent of Santo Domingo Province, which is now heavily developed. It still exists in remaining pockets of suitable habitat scattered throughout the region, including local land fills. It has been found under limestone rubble.

Etymology: *L. urbana*, of a city.

Arenabbottella wilhelmi (Pfeiffer, 1858)
(Figures 19, 129–135)

CHRESONYMY

Choanopoma wilhelmi Pfeiffer in Hjalmarsen and Pfeiffer, 1858: 139, pl. 2, figs. 1–3; Bland, 1861: 355; Pfeiffer, 1865: 110–111; Pfeiffer, 1876: 161; Kobelt, 1880: 277; Crosse, 1891: 165–166.

Abbottella wilhelmi (Pfeiffer, 1858): Henderson and Bartsch, 1920: 75; Bartsch, 1946: 143, 144, pl. 24, figs. 1–3.

Abbottella (Abbottella) wilhelmi (Pfeiffer, 1858): Watters, 2006: 83, 549; Watters, 2013: 13, 16, 17, figs. 4 T–X, 8 D.

Type Material: Not located, presumed lost.

Type Locality: “*In insulae Haiti.*” Pfeiffer continued that it “was collected under stones in moist places near Puerto Plata” [German translation].

Distribution and Habitat: This species occurs on the northern slopes of the Cordillera Septentrional from Puerto Plata to Nagua, including Pico Isabel de Torres, Loma Blanca at El Choco, and the north side of the outcrop between Río San Juan and Cabrera. Individuals are found from cloud forests to open, disturbed areas under limestone rubble.

Remarks: This species has been found suspending itself from mucus threads (Figure 131).

Etymology: Probably Rudolph Wilhelm Dunker (1809–1885), German conchologist.

Genus *Lagopoma* Bartsch, 1946

Type species: *Lagopoma lagopoma* Bartsch, 1946, by original designation.

Description: Shells small (ca. 9 mm in diameter), depressed turbinoid, sculpture of minute pustules on more-or-less weak spiral cords, cords more prominent in umbilicus, suture channeled, outer lip expanded, auriculate. Lip folded posteriorly and conspicuously notched. Radula as in subfamily (Figure 140).

Distribution: Samaná Peninsula of Dominican Republic (Figure 21). Snails live under leaf litter, limestone rubble, and on wet outcrops in mesic forests.

Remarks: Bartsch (1946) established *Lagopoma* as a monotypic genus characterized by a folded and notched outer lip. The enrolled lip also occurs in *Arenabbottella samanaensis* and *Abbottipoma gabbi*. In this study *Lagopoma* was found to be sister to *Abbottipoma*, and like that genus is endemic to the Samaná Peninsula.

***Lagopoma lagopoma* Bartsch, 1946**
(Figures 21, 136–141)

CHRESONYMY

Lagopoma lagopoma Bartsch, 1946: 142–143, pl. 23, figs. 1–3; Watters, 2006: 92, 324; Watters, 2013: 18, figs. 4 Y–CC, 8E.

Type Material: Holotype: USNM 356198 (2 specimens in lot, holotype listed as 5.0 mm long specimen).

Type Locality: “Laguna, 4 miles N of Samaná, Samaná Province, Dominican Republic.”

Distribution and Habitat: Occurs on the limestone outcrop of the Sierra de Samaná that occupies the north-eastern-most prominence, from El Valle to Loma Travesada. This species is found in association with *A. abbotti*.

Comparison with Other Species: This species is characterized by the peculiar folded auricle and notched outer lip.

Arenabbottella samanaensis and *Abbottipoma gabbi* occasionally have a similar auricle but lack the notch.

Etymology: Sp. *lago*, lake, lagoon + *-poma*, a standard ending for annulariid genera. The type was collected at Laguna.

Leiabbottella Watters, 2010

Type species: *Leiabbottella galaxius* Watters, 2010, by original designation.

Description: Shells small (ca. 10 mm in diameter), nearly planispiral, sculptureless except for microscopic axial threads and faint spiral ridges in umbilicus, outer lip narrowly expanded.

Distribution: Endemic to an outcrop of the Villa Trina Formation of the Río San Juan complex (Figure 21).

Remarks: In this phylogenetic study *Leiabbottella galaxius*, the type species, was a weakly supported member of the *Arenabbottella* clade. Conchologically it is very dissimilar from *Arenabbottella* species. At the risk of

perpetuating a possibly paraphyletic genus, we maintain *Leiabbottella* as a distinct genus pending further study. However, other smooth-shelled taxa previously assigned to *Leiabbottella* (*soluta* and *thompsoni*) are unrelated and are reassigned to the new genus *Preclaripoma*. Conchologically they differ primarily in the greatly expanded outer lip, which is very narrow in *L. galaxius*. The lack of shell sculpture appears to be convergent between the two groups.

Etymology: *G. leios*, smooth + *Abbottella*.

***Leiabbottella galaxius* Watters, 2010**

(Figures 21, 142–145)

CHRESONYMY

Leiabbottella galaxius Watters, 2010: 17–19, pl. 1, figs. 5, 6; Watters, 2013: 10, 18–19, figs. 2 J–L, 8 F.

Type Material: Holotype: UF 434779; Paratype: UF 434780(1); Paratypes: BMSM 17972(2); Paratype: OSUM 35491(1), all from the type locality.

Type Locality: “Dominican Republic, Samaná Province, Samaná Peninsula, along Rt. 5 between Santa Bárbara de Samaná and Sánchez, in the southern foothills of the Sierra de Samaná.” However, subsequent extensive collections in the area of the original type locality have failed to find this species. All other records place it exclusively on an outcrop of the Villa Trina Formation between Río San Juan and Cabrera. It seems certain that the original type locality was a mislabeled lot and in error. The type locality is here corrected to “outcrop 0.5 km NNE of Caro Clara, María Trinidad Sánchez Province, Dominican Republic.”

Distribution and Habitat: Endemic to an outcrop of the Villa Trina Formation of the Río San Juan complex, an area < 150 km². This is undifferentiated limestone, siltstone, and marl of Upper Miocene–Lower Pliocene age (Draper et al., 1991). All specimens seen were found from sea level to 30 m elevation. At Abreu, individuals were found within several meters of the sea at <1 m elevation.

Etymology: Gr. *galaxius*, an allusion to having the appearance of the Milky Way Galaxy.

Genus *Meganiphe* Thompson, 1978

Type Species: *Meganiphe rhexta* Thompson, 1978, by original designation.

Description: Shell small (8–10 mm in diameter), turbinate, whorls adnate, nondecollate. Moderately wide umbilicus. Axial sculpture of distantly spaced, greatly expanded, erect and undulating lamellae, ca. 12–14 on

final whorl. Spiral sculpture absent. Aperture circular, lip greatly expanded rather evenly but less so facing body whorl, barely separated from body whorl, composed of numerous greatly expanded lamellae, gently reflected abaperturally, undulating, weakly auriculate. Operculum multispiral with erect, calcareous lamella that is reflected to form almost flat plate. Radula as in subfamily.

Distribution: Endemic to Loma del Puerto (Figures 18, 153fig10).

Remarks: *Meganiphe* is apparently a narrowly endemic, monotypic genus. It is most closely related to *Rolleia*, which occurs in the same high elevation habitats. This appears to be an offshoot of *Rolleia* with exaggerated sculpture.

Etymology: *L. mega*, giant + *G. nipha*, snowflake.

***Meganiphe rhexta* Thompson, 1978**

(Figures 19, 146–153)

CHRESONYMY

Meganiphe rhexta Thompson, 1978: 43–48, figs. 1–4; Abbott, 1989: 53; Watters, 2006: 92, 441–442; Aiken, 2018: 4–9.

Type Material: Holotype: UF 22745; Paratypes: UF 22746(1), 22747(1); Paratype: USNM 711132(6); Paratype: GTW 8227a(1).

Type Locality: “Dominican Republic, Puerto Plata Province, Loma del Puerto, Yaroa, 700 m elevation.” This site appears to be on the border between Santiago and Puerto Plata provinces.

Distribution and Habitat: This beautiful species is apparently endemic to Loma del Puerto. This is a portion of the La Piedra Member of the Villa Trina Formation. It is characterized by massive, cliff-forming reefal limestone of Upper Miocene–Lower Pliocene age (Zoeten et al., 1991). The habitat is a 700–800 m elevation, nearly inaccessible ridge in a cloud forest, on limestone blocks with lichens, moss, and ferns (Aiken, 2018, and figures).

Remarks: Shells may be banded or not. This species co-occurs with the lizard *Anolis distichus ignigularis* Mertens, 1939, which may be predaceous on them (Aiken, 2018).

Etymology: Gr. *rhexta*, brittle. *Meganiphe rhexta* – Brittle Giant Snowflake.

Genus *Microabbottella* new genus

Type species: *Abbottella* (*Abbottella*) *diadema* Watters, 2013.

Description: Shell minute (4–6 mm in diameter), tur-
 binate, whorls adnate except just before lip. Umbilicus
 wide. Protoconch of ca. 1.5 minutely pustulose whorls but
 demarcation between protoconch and teleoconch not
 well- defined. Teleoconch of 2.5–2.75 whorls. Axial
 sculpture of numerous, crowded, low lamellae. Spiral
 sculpture present only as keels. The axial sculpture on
 keels forms very dense, finely serrate edge. Aperture
 double, circular, solute from final whorl. Inner lip smooth,
 narrowly exerted. Outer lip slightly expanded, consisting
 of numerous fused lamellae, with two low auricles 180°
 apart. Operculum multispiral with oblique, erect, cal-
 careous lamella. Radula and anatomy unknown.

Distribution: Endemic to Loma Travesada (Figure 20).

Remarks: This genus has the smallest shells of any
 abbotellines and has the fewest number of teleoconch
 whorls (<3); the shells are also among the smallest known
 annulariids. The curious combination of tightly packed
 axial sculpture and prominent spiral cords is unlike any
 other annulariid. Currently this is a monotypic genus.
 Although preserved material was not available for phy-
 logenetic work, the unique conchological features indicate
 a genus apart from other abbotellines. Its apparently very
 limited range on a single hill in the eastern-most Samaná
 Peninsula suggests it may have evolved in isolation there
 when the peninsula was still an island.

Etymology: *L. micro*, very small + *Abbottella*.

***Microabbottella diadema* (Watters, 2013)**

(Figures 20, 154–157)

CHRESONYMY

Abbottella (*Abbottella*) *diadema* Watters, 2013: 4, 6, figs. 1
 F–J, 5 P, 7 B.

Type Material: Holotype, UF 456814; Paratypes: UF
 456815(5), from the type locality.

Type Locality: “Dominican Republic, Samaná Province,
 Cabo Cabrón, at 280 m. ca. 19.34° N, –69.25° W.”

Distribution and Habitat: Known only from the type
 locality at the isolated Loma Travesada of the Sierra de
 Samaná under limestone boulders on a slope in virgin rain
 forest; abundant. It may occur in <10 km².

Etymology: Gr. *diadema*, headband, crown.

Genus *Preclaripoma* new genus

Type Species: *Leiabbottella thompsoni* Watters, 2013.

Description: Shells large for subfamily (9–15 mm in
 diameter), nearly planispiral, sculptureless except for

microscopic axial threads and faint spiral ridges in um-
 bilicus. Outer lip greatly expanded. Operculum as in
 subfamily.

Distribution: The few records indicate isolated localities
 in the Cordillera Septentrional and the Los Haitises of
 the Majugal area (Figure 21).

Remarks: Originally considered members of *Leiabbot-
 tella*, results here indicate these taxa are unrelated to that
 genus and constitute a new taxon. The lack of sculpture
 seen in *Leiabbottella* and *Preclaripoma* is convergent.
Preclaripoma is weakly supported as a sister group of
Abbottella. These are very rare species in collections.

Etymology: *L. preclarus*, very beautiful, splendid +
-poma.

Key to Species

- 1) Whorls ca. 3× as high as wide, outer lip barely adnate
 to preceding whorl *soluta*
- 1) Whorls ca. 4× as high as wide, outer lip broadly adnate
 to preceding whorl *thompsoni*

***Preclaripoma soluta* (Pfeiffer, 1852)**

(Figures 21, 158–161)

CHRESONYMY

Choanopoma solutum “Richard” Pfeiffer, 1851: 155 [*no-
 men nudum*]; Adams and Adams, 1856: 296; Hjalmarson
 and Pfeiffer, 1858: 138–139; Bland, 1861: 355; Pfeiffer,
 1865: 110; Pfeiffer, 1876: 160; Crosse, 1891: 169.

Choanopoma? *solutum* “Richard.” Pfeiffer, 1852a: 167;
 Pfeiffer, 1853: 117; Pfeiffer, 1858b: 102.

Cyclostoma solutum (“Richard”): Pfeiffer, 1854b: 295, pl.
 39, figs. 8–10; Pfeiffer, 1858a: 188.

Cyclostoma (*Choanopoma*) *solutum* “Richard” Pfeiffer,
 1852: Shuttleworth, 1856: 261–263, 270.

Cyclostoma solutum “Richard” Pfeiffer, 1852: Reeve,
 1862: pl. 23, figs. 160a,b.

Choanopoma solutum “Richard” Pfeiffer, 1852: Kobelt,
 1880: 277.

Abbottella solutum (Pfeiffer, 1852): Henderson and
 Bartsch, 1920: 75.

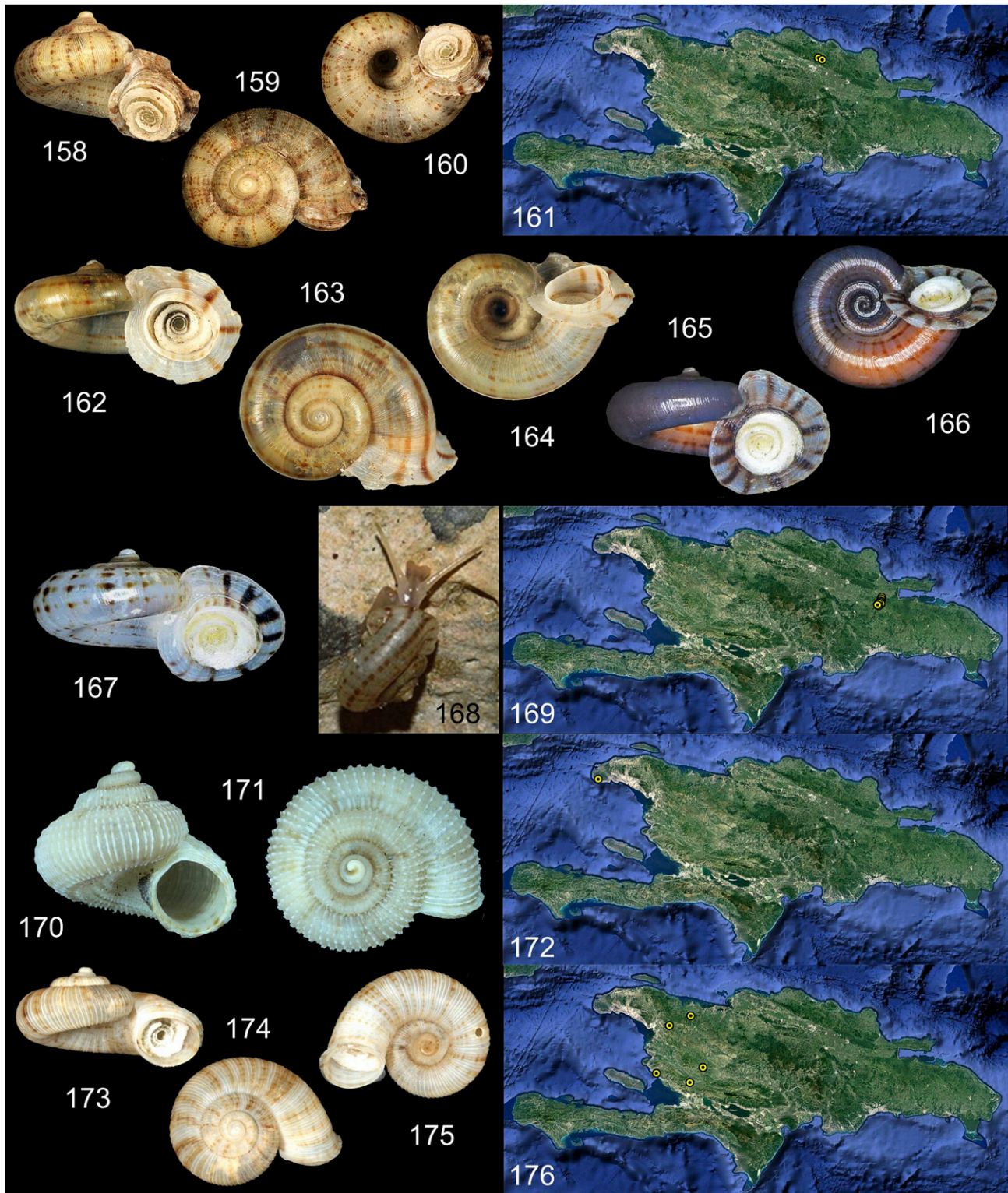
Choanopoma (*Abbotella* [*sic*]) *solutum* “Richard” Pfeiffer,
 1852: Clench and Aguayo, 1937: 67.

Incertipoma solutum (Pfeiffer, 1852): Bartsch, 1946: 171,
 173–174, pl. 30, figs. 2–4.

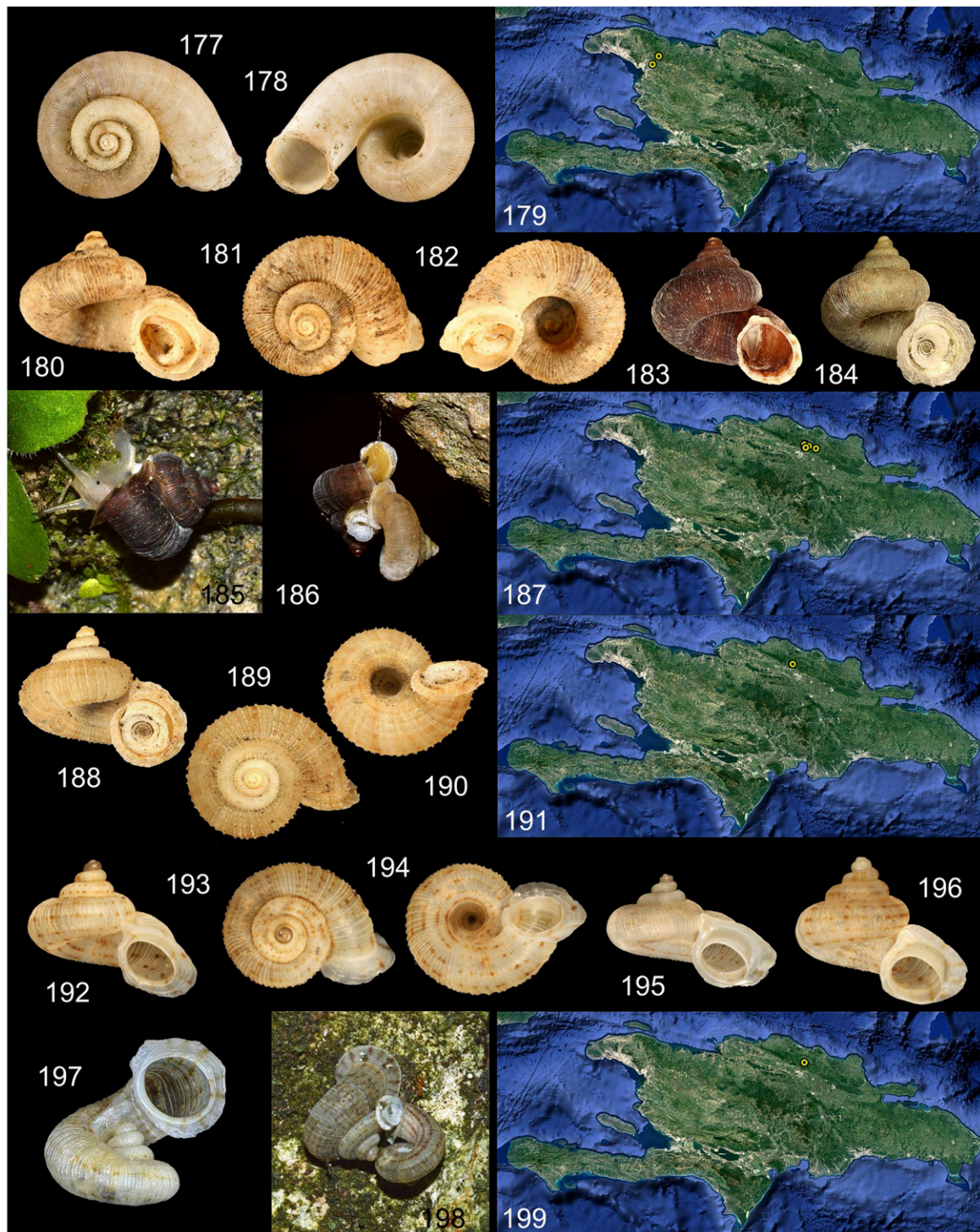
Rolleia ? *soluta* (Pfeiffer, 1852): Watters, 2006: 93,
 487–488.

Leiabbottella soluta (Pfeiffer, 1852): Watters, 2010: 18, 19;
 Watters, 2013: 9, 11, 17, figs. 2 F–I, 7 D; Aiken, 2018: 7.

Type Material: ? NHMUK, not located, but in Cuming
 collection, *vide* Shuttleworth, 1856: 262.



Figures 158–176. *Preclaripoma*, *Rolleia*. **158–161.** *Preclaripoma soluta* (Pfeiffer, 1852). **158–160.** GTW 16924a (13.5 mm diameter). **161.** Distribution map. **162–169.** *Preclaripoma thompsoni* (Watters, 2013). **162–164.** **Holotype**, UF 456799 (13.7 mm diameter). **165–166.** Aiken coll. (13.4 mm diameter, photo ©S. Aiken). **167.** Aiken coll. (12.9 mm diameter, photo ©S. Aiken). **168.** Live individual (photo ©S. Aiken). **169.** Distribution map. **170–172.** *Rolleia bombardopolensis* (Bartsch, 1946). **170–171.** **Holotype**, USNM 504085 (7.1 mm diameter). **172.** Distribution map. **173–176.** *Rolleia haitensis* Bartsch, 1946. **173–175.** **Holotype**, USNM 504088 (12.0 mm diameter, photo courtesy of USNM). **176.** Distribution map.



Figures 177–199. *Rolleia*. **177–179.** *Rolleia martensi* (Maltzan, 1888). **177–178.** Possible **syntype**: ZMB 40725 (15 mm diameter, photo courtesy Malacological Collection, Museum für Naturkunde Berlin, Leibniz Institute for Research in Evolution and Biodiversity at the Humboldt University, photography L. Maitas). **179.** Distribution map. **180–187.** *Rolleia oberi* Watters and Duffy, 2010. **180–182.** Holotype UF 434775, 10.3 mm diameter. **183.** GTW 14180b (7.3 mm diameter). **184.** GTW 14180b (8.6 mm diameter). **185.** Live individual (photo ©S. Aiken). **186.** Mating pair suspended on mucous threads (photo ©S. Aiken). **187.** Distribution map. **188–191.** *Rolleia paradoxa* (Watters, 2013). **188–190.** **Holotype**, UF 456812 (7.8 mm diameter). **191.** Distribution map. **192–199.** *Rolleia simonakeni* **new species**. **192–194.** Holotype, OSUM 46107 (9.6 mm diameter). **195.** **Paratype**, UF 525639 (9.0 mm diameter). **196.** **Paratype**, BMSM 128507 (10.6 mm diameter). **197.** Hyperstrophic individual (8.2 mm length, photo ©S. Aiken). **198.** Mating pair (photo ©S. Aiken). **199.** Distribution.

Type Locality: “Island of Santo Domingo.” Originally restricted by Watters (2012) to “the southern edge of Los Haitises Mountains, N of Majagual, ca. 12 km NW of Sabana Grande de Boyá, Monte Plata Province, Dominican Republic.” However, this was found to be a different species described as *Leiabbottella thompsoni* Watters, 2013. The type locality was corrected by Watters (2013) to “Yásica Abajo, Puerto Plata Province, Dominican Republic.”

Distribution and Habitat: Known only from the region of Loma del Puerto near Lajas de Yaroa and Gurabito de Yaroa in the Cordillera Septentrional, between Puerto Plata and Santiago de Los Caballeros; ca. 500–900 m elevation. It lives in the soil under rocks (Aiken, 2018).

Remarks: This species occurs at higher elevations than *P. thompsoni*, up to at least 900 m.

Etymology: *L. solutus*, dissolved; possibly used here to refer to the openly coiled whorls.

***Preclaripoma thompsoni* (Watters, 2013)**

(Figures 21, 162–169)

CHRESONYMY

Leiabbottella thompsoni Watters, 2013: 9–11, 17, 18, figs. 2 A–E, 7 E.

Type Material: Holotype: UF 456799; Paratypes: UF 236225(91), from the type locality.

Type Locality: “Dominican Republic, Monte Plata Province, 5 km N of Majagual [Majugual], at 150 m. ca. 19.09° N, –69.83° W.”

Distribution and Habitat: Found in the karstic region of Los Haitises between the Cordillera Central and the Cordillera Oriental around Guaragao and Majugual on and at the base of limestone knolls and in ravines in mesic forests under debris and leaf litter. The Majugual region is the western part of the Cevicos Formation, composed of karsted, massive limestone blocks of Upper Miocene–Lower Pliocene age (Draper and Lewis, 1991). All specimens seen were found between 100–320 m elevation. Locally common.

Etymology: Named for the late Dr. Fred Thompson, Curator, UF, who collected the types.

Genus *Rolleia* Crosse, 1891

Type Species: *Cyclotus martensi* Maltzan, 1888, by original designation.

Petaspipoma Bartsch, 1946, is a synonym.

Description: Shell medium-sized for family (8–15 mm in diameter), depressed to turbinoid, terminal portion of final whorl solute from previous whorl and may be deflected anteriorly. Axial sculpture of numerous close-set, very fine threads or low lamellae. Spiral sculpture as weak cords that may be limited to umbilicus or may be entirely absent. Outer lip widely expanded in most species.

Distribution: Specimens are very rare in collections and the ranges of the species are not well-known. All appear to be upland species in the Massif du Nord and Montagnes Noires of Haiti and the Cordillera Septentrional of the Dominican Republic (Figure 20). These highlands are largely unexplored and nearly impenetrable. Given the amount of endemism in this group, it is to be expected that other species undoubtedly await discovery.

Remarks: The Haitian species may be unrelated to those from the Dominican Republic. *Paradoxa* and *bombardopolensis* also may constitute a separate genus but require additional material.

Etymology: Hermann Rolle (f. 1887–1911), German shell dealer.

Key to Species

- 1) Operculum fits within aperture, spiral sculpture absent or present only in umbilicus 2
- 1) Operculum too large to fit in aperture, spiral sculpture of weak cords over whorls 5
- 2) Shell nearly smooth, final portion of last whorl widely solute *martensi*
- 2) Shell with coarser axial sculpture, final portion of last whorl narrowly solute 3
- 3) Outer lip narrowly expanded *haitensis*
- 3) Outer lip widely expanded 4
- 4) Axial sculpture close-set and barely separated by width of thread *oberi*
- 4) Axial sculpture separated by gaps several times wider than thread *simonaikeni*
- 5) Outer lip widely expanded and notched *paradoxa*
- 5) Outer lip narrowly expanded and complete *bombardopolensis*

***Rolleia bombardopolensis* (Bartsch, 1946)**

(Figures 20, 170–172)

CHRESONYMY

Petaspipoma bombardopolense Bartsch, 1946: 138–139, pl. 21, figs. 4–6.

Abbottella (*Petaspipoma*) *bombardopolensis* (Bartsch, 1946): Watters, 2006: 84, 179.

Abbottella (*Gundlachtudora*) *bombardopolensis* (Bartsch, 1946): Watters, 2013: 17–18, figs. 1 DD, 8 I.

Type Material: Holotype: USNM 504085 (2 specimens in lot, holotype listed as 6.5 mm long specimen).

Type Locality: “Crevices in rocks in a ravine a little west of Bombardopolis, Haiti.”

Distribution and Habitat: *Rolleia bombardopolensis* is known from Bombardopolis and Terre Neuve in the western-most extent of the Cordillera Centrale in Haiti. Its habitat is unknown.

Remarks: The structure of the operculum, which is nearly flat and cannot be withdrawn into the aperture, separates this from all other abbotellines except *R. paradoxa*. The shell sculpture of both is consistent with *Rolleia* and the species occupy the known range of *Rolleia* but their assignment here is highly conjectural. No suitable preserved material was available. The opercular features are here considered a species-level characteristic. The Cuban species *decolorata* Pfeiffer, 1859, is maintained in Bartsch’s subgenus *Gundlachtudora* but probably belongs to the Abbottellinae as well.

Etymology: From Bombardopolis, Haiti.

***Rolleia haitensis* Bartsch, 1946**

(Figures 20, 173–176)

CHRESOONYMY

Rolleia haitensis Bartsch, 1946: 140, 141–142, pl. 23, figs. 7–9; Watters, 2006: 93, 288; Watters and Duffy, 2010b: 187, figs. 7–9; Watters, 2013: 20, 22, figs. 5 A–F, 7 I.

Type Material: Holotype: USNM 504088.

Type Locality: “Ennery, Haiti.”

Distribution and Habitat: It is known from the Montagnes Noires range of Haiti. Its habitat is unknown.

Remarks: It is possible that more than one species has been treated under this name.

Etymology: From Haiti.

***Rolleia martensi* (Maltzan, 1888)**

(Figures 20, 177–179)

CHRESOONYMY

Cyclotus martensi Maltzan, 1888: 179.

Rolleia martensi (Maltzan, 1888): Crosse, 1891: 163–164, pl. 2, fig. 4; Wenz, 1939: 550, fig. 1471; Bartsch, 1946: 140–141, pl. 23, figs. 4–6; Watters, 2006: 93, 349; Watters and Duffy, 2010b: 187, figs. 10, 11; Watters, 2013: 20.

Rolleia martensii [sic] (Maltzan, 1888): Thiele, 1929: 134.

Type Material: Possible **syntype:** ZMB 40725.

Type Locality: “*Sanssouci in parte meridionali insulae Haiti.*” Bartsch (1946: 141) gave “Plaisance, the type locality.” This is incorrect; the Sans-Souci Palace is located in Milot, 27 km east of Plaisance.

Distribution and Habitat: This rarely seen species is found in the Massif du Nord and Montagnes Noires of Haiti. Habitat information is lacking.

Etymology: Karl Eduard von Martens (1831–1904), German conchologist at Museum für Naturkunde, Berlin.

***Rolleia oberi* Watters and Duffy, 2010**

(Figures 20, 180–187)

CHRESOONYMY

Rolleia oberi Watters and Duffy, 2010b: 185, 187, figs. 1–6; Watters, 2013: 20, 22, figs. 5 G–N, 8 G; Aiken, 2018: 7.

Type Material: Holotype: UF 434775; Paratypes: UF 434776(3); Paratypes: BMSM 17970(2); Paratypes: OSUM 35489(2), all from the type locality.

Type Locality: “On road half way between Santiago de los Caballeros and Puerto Plata, El Puerto, La Has, Puerto Plata Province, Dominican Republic, at 830–1000 m in the Cordillera Septentrional.” This road is Carretera Turistica Gregorio Luperon.

Distribution and Habitat: This species is probably limited to the area of Loma del Puerto between Puerto Plata and Santiago de Los Caballeros in the Cordillera Septentrional. All specimens seen were found between 700–800 m elevation on limestone outcrops in cloud forest.

Remarks: As with a few other abbotellines (and helicinids), this species is found in two different colors – brown and yellow/white. This may be a sexual characteristic with males being the yellow/white morph. This species has been observed suspending itself from mucus thread(s) (Figure 186).

Etymology: Jim Ober, collector of the types.

***Rolleia paradoxa* (Watters, 2013)**

(Figures 20, 188–191)

CHRESOONYMY

Abbottella (*Gundlachtudora*) *paradoxa* Watters, 2013: 8, 9, 18, figs. 1 Z–CC, 9 F.

Type Material: Holotype: UF 456812; Paratypes: UF 456813(22), from the type locality.

Type Locality: “Dominican Republic, Santiago Province, Loma Diego de Ocampo, at 1200 m. ca. 19.62° N, - 70.76° W.”

Distribution and Habitat: Known only from Loma Diego de Ocampo of the Cordillera Septentrional, on limestone rocks on the mountain crest in dense forest with thick vegetative debris, mosses, and epiphytes. Loma Diego de Ocampo is located north of Santiago de Los Caballeros and is the highest point of the Cordillera Septentrional at 1,200 m.

Remarks: Watters (2013) placed this species under *Gundlachtudora* based on opercular features. However, the shell sculpture is unlike that genus but more similar to *Rolleia*. See Remarks under *Rolleia bombardopolensis*.

Etymology. *L. paradoxus*, strange, contrary to expectation.

Rolleia simonaikei new species

(Figures 20, 192–199)

CHRESOONYMY

Rolleia sp. Aiken, 2018: figs. top of p. 8.

Description: Shell small (largest specimen seen, 11.0 mm in diameter including outer lip; smallest seen, 8.0 mm in diameter including outer lip; holotype 9.6 mm in diameter including outer lip), depressed turbinoid, widely umbilicate. Whorls adnate except for just behind outer lip. Nuclear whorls 1.5, smooth, minute, white or brown, weakly demarcated from teleoconch whorls. Teleoconch whorls 3. Axial sculpture of minute, low, erect lamellae (90–100 on final whorl), evenly produced all around, more or less evenly distributed but closer set near lip, with microscopic threads between some lamellae. Spiral sculpture absent. Aperture deflected anteriorly. Outer lip very broadly expanded, narrower facing umbilicus, just touching previous whorl, somewhat concave posteriorly, composed of numerous fused lamellae, with wide posterior auricle. Inner lip round, exerted, projecting beyond outer lip. Shell white or pale tan with ca. 9 spiral bands of smudged tan spots or dashes that show through into aperture. Operculum not preserved with specimens but based on photographs of live animals (Aiken, 2018), composed of single, reflected spiral lamella. Radula unknown. Preserved material was not available for phylogenetic analysis.

Type Material: Holotype: OSUM 46107 (9.6 mm in diameter); **Paratypes:** UF 525639(1), 9.0 mm in diameter; BMSM 128507 (1), 10.6 mm in diameter.

Additional Material: GTW 17281a(1); Aiken coll. (29), all from the type locality.

Type Locality: Dominican Republic, Santiago Province, Loma del Puerto, 1.4 km NNW of Lajas de Yaroa.

Distribution and Habitat: Known only from a crevice in a single house-sized limestone block on Loma del

Puerto at 685 m elevation in a cloud forest. This is a portion of the La Piedra Member of the Villa Trina Formation. It is characterized by massive, cliff-forming, reefal limestone of Upper Miocene–Lower Pliocene age (Zoeten et al., 1991).

Remarks: This species may occupy the narrowest range of any annulariid, having been found only in a single fissure on a single small outcrop (Aiken, 2018). It is also unique in having the only known dextral hyperstrophic example recorded for the family (Figure 197).

Etymology: Named for Simon Aiken (UK), collector of the types and generous contributor to this and other studies.

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Appendix 1. Specimens used in phylogenetic study. DR = Dominican Republic.

Appendix 1

Taxon	GenBank (COI/ 12S/ H3)	Source Accession	Locale
<i>Abbottella crataegus</i> (Watters, 2016)	MT119707/ NA/ NA	GTW 16492c	Majugual, DR
<i>Abbottella moreletiana</i> (Crosse, 1873)	MT119681/ MT119719/ MT119733	GTW 7071g	Boca del Infierno, DR
<i>Abbottella domingoensis</i> (Bartsch, 1946)	MT119706/ MT119717/ MT119734	GTW 16491c	Rio Naranjo, DR
<i>Abbottella domingoensis</i> (Bartsch, 1946)	MT119705/ MT119718/ NA	GTW 16491b	Puerto Bonito, DR
<i>Abbottipoma abbotti</i> (Bartsch, 1946)	MT119695/ MT119723/ NA	GTW 10829b	El Valle, DR
<i>Abbottipoma abbotti</i> (Bartsch, 1946)	MT119696/ MT119724/ NA	GTW 10829c	El Valle, DR
<i>Abbottipoma crossei</i> (Bartsch, 1946)	MT119691/ MT119726/ MT119730	GTW 9432b	Anadel, DR
<i>Abbottipoma crossei</i> (Bartsch, 1946)	MT119692/ NA/ NA	GTW 9432c	Talanquera, DR
<i>Arenabbottella mellosa</i> (Watters and Duffy, 2010)	MT119679/ NA/ NA	GTW 7020f	Río San Juan, DR
<i>Arenabbottella rosaliae</i> (Pfeiffer, 1858)	MT119712/ MT119722/ NA	GTW 16507b	Cabarete, DR
<i>Arenabbottella rosaliae</i> (Pfeiffer, 1858)	MT119713/ NA/ NA	GTW 16507c	Monkey Jungle, DR
<i>Arenabbottella rosaliae</i> (Pfeiffer, 1858)	MT119711/ NA/ NA	GTW 16507a	Sosúa, DR
<i>Arenabbottella sosuaensis</i> (Bartsch, 1946)	MT119698/ MT119721/ MT119731	GTW 13728c	Cabarete, DR
<i>Arenabbottella sosuaensis</i> (Bartsch, 1946)	MT119699/ NA/ NA	GTW 13728f	Sosúa, DR
<i>Adamsiella ignilabris</i> (Adams, 1849)	MT119687/ NA/ NA	GTW 7244g	Windsor Cave, Jamaica
<i>Annularia anomala</i> (Adams, 1850)	JQ964718/ JQ990572/ NA	ANSP:JBS263-01	Manchester Parish, Jamaica
<i>Annularia chittyi</i> (Adams, 1849)	JQ964706/ JQ990560/ NA	USDA:97J25-01	St. Elizabeth Parish, Jamaica
<i>Annularia fimbriatula</i> (Sowerby, 1825)	JQ964705/ JQ990559/ NA	ANSP:JBS148-01	St. Elizabeth Parish, Jamaica
<i>Annularia fimbriatula</i> (Sowerby, 1825)	JQ964707/ JQ990561/ NA	USDA:97J1-01	Hanover Parish, Jamaica
<i>Annularia fimbriatula</i> (Sowerby, 1825)	JQ964708/ JQ990562/ NA	ANSP:JBS378-01	St. Ann Parish, Jamaica
<i>Annularia hillianiana hillianiana</i> (Adams, 1845)	JQ964709/ JQ990563/ NA	ANSP:JBS253A-01	Clarendon Parish, Jamaica
<i>Annularia hillianiana leporilabre</i> (Adams, 1851)	JQ964710/ JQ990564/ NA	ANSP:JBS133-01	Manchester Parish, Jamaica
<i>Annularia lima</i> (Adams, 1845)	JQ964711/ JQ990565/ NA	ANSP:JBS1-01	St. Elizabeth Parish, Jamaica
<i>Annularia lincina</i> (Linnaeus, 1758)	JQ964712/ JQ990566/ NA	ANSP:JBS398-01	St. Catyherine Parish, Jamaica
<i>Annularia lincinella</i> (Lamarck, 1822)	MT119690/ NA/ NA	GTW 9209d	Rio Cobre, Jamaica
<i>Annularia mitus</i> (Pfeiffer, 1852)	JQ964713/ JQ990567/ NA	ANSP:JBS99-01	St. Catyherine Parish, Jamaica
<i>Annularia pisum</i> (Adams, 1849)	JQ964714/ JQ990568/ NA	ANSP:JBS188-02	Portland Parish, Jamaica
<i>Annularia scabricula</i> (Sowerby, 1843)	JQ964716/ JQ990570/ NA	ANSP:JBS595-01	St. Elizabeth Parish, Jamaica
<i>Annularia triplopoma</i> (Baker, 1934)	JQ964717/ JQ990571/ NA	ANSP:JBS69B-01	Trelawny Parish, Jamaica
<i>Annularisca hendersoni</i> (Torre and Bartsch, 1941)	JQ964763/ JQ990616/ NA	ANSP:CO35B-01	Holguin, Cuba
<i>Annularisca victoris</i> (Torre and Bartsch, 1941)	MT119683/ NA/ NA	GTW 7163e	Playa El Baga, Cuba
<i>Annularisca victoris</i> (Torre and Bartsch, 1941)	KX496697/ NA/ NA	GTW 7163e	Playa El Baga, Cuba
<i>Chondropoma laetum</i> (Poey, 1857)	KX496694/ NA/ NA	GTW 15040a	Velasco, Cuba
<i>Chondropoma oculum</i> (Watters and Duffy, 2010)	MT119684/ NA/ NA	GTW 7166d	Pedernales, DR
<i>Chondropoma pupiforme</i> (Sowerby, 1843)	KX496717/ NA/ NA	UF 48724	Anguilla
<i>Chondropoma</i> sp.	KX496702/ NA/ NA	GTW 15050a	Rafael Freyre, Cuba
<i>Chondropoma</i> sp.	KX496704/ NA/ NA	GTW 15046a	Guardalavaca, Cuba
<i>Chondropomella magnifica</i> (Pfeiffer, 1852)	KX863609/ NA/ NA	OSUM 42368	Puerto Escondido, DR
<i>Chondropomella magnifica</i> (Pfeiffer, 1852)	KX863610/ KX863590/ NA	OSUM 42358	Bartolomé, DR
<i>Chondropomium weinlandi</i> (Pfeiffer, 1862)	KX863598/ KX863577/ NA	OSUM 42362	Bombita, DR
<i>Chondropomium weinlandi</i> (Pfeiffer, 1862)	KX863599/ KX863578/ NA	OSUM 42363	Bombita, DR
<i>Chondropomium weinlandi</i> (Pfeiffer, 1862)	KX863600/ KX863579/ NA	OSUM 42378	Bartolomé, DR
<i>Chondropomium weinlandi</i> (Pfeiffer, 1862)	KX863601/ NA/ NA	OSUM 42361	Galindo Adrento, DR
<i>Chondropomium weinlandi</i> (Pfeiffer, 1862)	KX863602/ KX863581/ NA	OSUM 42377	El Limón, DR
<i>Chondropomium weinlandi</i> (Pfeiffer, 1862)	KX863611/ KX863591/ NA	OSUM 42359	Bartolomé, DR

(Continued)

Appendix 1. (Continued)

Appendix 1

Taxon	GenBank (COI/ 12S/ H3)	Source Accession	Locale
<i>Chondropomium weinlandi</i> (Pfeiffer, 1862)	KX863613/ KX863593/ NA	OSUM 42379	Bartolomé, DR
<i>Chondropomium weinlandi</i> (Pfeiffer, 1862)	KX863618/ KX863597/ NA	OSUM 42364	Bombita, DR
<i>Clydonopoma bartschi</i> (Watters, 2012)	MT119703/ NA/ NA	GTW 14630e	Hispaniolan Pine Biome, DR
<i>Clydonopoma nobile</i> (Pfeiffer, 1852)	KX496730/ NA/ NA	GTW 7089b	Virgen de San Rafael, DR
<i>Clydonopoma nobile</i> (Pfeiffer, 1852)	KX863603/ KX863582/ NA	OSUM 42366	Virgen de San Rafael, DR
<i>Clydonopoma poloense</i> (Bartsch, 1946)	KX863604/ KX863583/ NA	OSUM 42372	Carbon de Polla, DR
<i>Clydonopoma pumilum</i> (Watters and Duffy, 2010)	KX496677/ NA/ NA	GTW 7172b	Las Mercedes, DR
<i>Colobostylus retrorsa</i> (Adams, 1850)	MT119704/ NA/ MT119744	GTW 15700a	Ivy Store, Jamaica
<i>Colobostylus retrorsa</i> (Adams, 1850)	JQ964715/ JQ990569/ NA	ANSP:JBS147-01	Clarendon Parish, Jamaica
<i>Crossepoma marmoreum</i> (Watters and Duffy, 2010)	MT119686/ NA/ NA	GTW 7170i	Cabo Rojo, DR
<i>Crossepoma vermiculatum domingoense</i> (Bartsch, 1946)	KX863614/ NA/ NA	OSUM 42380	Oviedo, DR
<i>Crossepoma vermiculatum domingoense</i> (Bartsch, 1946)	KX863605/ KX863584/ NA	OSUM 42373	Carbon de Polla, DR
<i>Crossepoma vermiculatum domingoense</i> (Bartsch, 1946)	KX863606/ KX863585/ NA	OSUM 42367	Río Palomino, DR
<i>Crossepoma vermiculatum domingoense</i> (Bartsch, 1946)	KX863607/ NA/ NA	OSUM 42374	Cabral, DR
<i>Crossepoma vermiculatum domingoense</i> (Bartsch, 1946)	KX863608/ NA/ NA	OSUM 42376	El Limón, DR
<i>Crossepoma vermiculatum vermiculatum</i> (Bartsch, 1946)	MT119682/ NA/ MT119735	GTW 7088b	Oviedo, DR
<i>Diplopoma crenulatum</i> (Poteiz and Michaud, 1838)	MT119680/ NA/ NA	GTW 7064d	Antigua
<i>Lagopoma lagopoma</i> (Bartsch, 1946)	MT119694/ MT119725/ NA	GTW 10081b	El Valle, DR
<i>Leiabbottella galaxius</i> Watters, 2010	MT119700/ NA/ MT119732	GTW 13813b	Caro Clara, DR
<i>Preclaripoma thompsoni</i> (Watters, 2013)	MT119708/ NA/ NA	GTW 16493e	Majugual, DR
<i>Meganiphe rhecta</i> Thompson, 1978	MT119697/ MT119720/ MT119729	GTW 11371b	Loma del Puerto, DR
<i>Opisthosiphon bahamensis</i> (Pfeiffer, 1865)	MT119688/ MT119727/ MT119738	GTW 8707e	Great Exuma, Bahamas
<i>Opisthosiphon caguanense</i> (Torre and Bartsch, 1941)	MT119715/ MT119728/ NA	GTW 16595a	Cayo Coco, Cuba
<i>Parachondria clenchi</i> (Bartsch, 1946)	MT119714/ NA/ MT119748	GTW 16518b	Talanquera, DR
<i>Parachondria canescens</i> (Pfeiffer, 1852)	MT119678/ NA/ NA	GTW 179e	Holguin, Cuba
<i>Parachondria dentatus</i> (Say, 1825)	MT119689/ NA/ MT119746	GTW 8709f	Key West, USA
<i>Parachondria gettlemani</i> (Watters, 2012)	MT119702/ NA/ MT119737	GTW 14626b	Virgen de San Raphael, DR
<i>Parachondria pilsbryi</i> (Bartsch, 1946)	MT119710/ NA/ MT119750	GTW 16505b	La Isabella, DR
<i>Parachondria trachyderma</i> (Pilsbry, 1933)	MT119709/ NA/ MT119747	GTW 16495f	Cabrera, DR
<i>Pomatias elegans</i> (Müller, 1774)	JQ964789/ JQ990643/ NA	USDA_07FRA03-01	Aquitaine, France
<i>Pomatias elegans</i> (Müller, 1774)	KX496707/ NA/ NA	OSUM 43254	Órtilos, Hungary
<i>Rolleia oberi</i> Watters and Duffy, 2010	MT119701/ NA/ NA	GTW 14180b	La Cumbre, DR
<i>Superipoma asymmetricum</i> (Pilsbry, 1933)	KX863615/ NA/ NA	OSUM 42369	Puerto Escondido, DR
<i>Superbipoma superbum</i> (Henderson and Simpson, 1902)	KX86361/ KX863592/ NA	OSUM 42360	Bartolomé, DR
<i>Tessaripoma alyshae</i> (Watters and Duffy, 2010)	MT119685/ NA/ NA	GTW 7169c	Puerto Alejandro, DR
<i>Tudorella ferruginea</i> (Lamarck, 1822)	JQ964788.1/ JQ990642/ NA	USDA:Iber99A-01	Balearic Islands, Spain
<i>Tudorella sulcata</i> (Draparnaud, 1805)	GQ370447/ NA/ NA	RES1,2,3	Resquiadou, France
<i>Tudorella sulcata</i> (Draparnaud, 1805)	GQ370448/ NA/ NA	ROU1,2,3	Roucas-Blanc, France
<i>Xenopoma spinosissimum</i> Torre and Bartsch, 1941	MT119693/ NA/ NA	GTW 9436d	Cueto, Cuba