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GEOMETRIC MORPHOMETRIC ANALYSIS OF THE SHELL OF *CERION MUMIA* (PULMONATA: CERIONIDAE) AND RELATED SPECIES

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ABSTRACT: *Cerion mumia* is a complex of eight subspecies distributed along the north coast of Cuba from Pinar del Rio to Camaguey provinces. The geometric morphometric analysis presented here was aimed at identifying patterns of shell shape variation to test the hypothesis of colonisation through land bridges during the Eocene-Oligocene. *C. mumia cuspidatum*, the easternmost population, was similar in shape to the subspecies from the north coast of Havana, but showed morphometric differences suggesting allopatric speciation followed by dispersal. The shells from the west were more globose than those from Havana or the east, which tended to be more cylindrical, as shown by the thin-plate spline analysis. As a result of the morphometric analysis I propose to elevate *C. noriae* comb. nov. and *C. wrighti* comb. nov. to species rank and to include *C. noriae hondanum* comb. nov. as a subspecies of *C. noriae* comb. nov. I report a second locality of *C. noriae* comb. nov. at Playa Santa Fe formation from the late upper Pleistocene. Geometric morphometric techniques are useful in species identification through comparing new samples with type material.

KEY WORDS: Geometric morphometrics, patterns of variation, shell shape, land snails, *Cerion*

INTRODUCTION

The genus *Cerion* Röding, 1798 is endemic to the West Indies, with the distribution centre in Cuba and the Bahamas islands. The great geographic variation of its shell size, shape, sculpture and colour has made it a popular object of evolutionary research (GOULD & WOODRUFF 1986). The variation makes almost every population unique (GALLER & GOULD 1979).

Cerion mumia Bruguière, 1792 inhabits the northern coast of Cuba, including the provinces from Pinar del Rio, Havana, Matanzas in western Cuba and Camaguey in central Cuba, with several subspecies described based mainly on shell shape and colour (PILSBRY & VANATTA 1896, 1898, PILSBRY 1901, CLENCH & AGUAYO 1953).

Some other species related to *C. mumia* share similar characters: cylindrical shells, usually quite high, coarsely ribbed, whitish or marbled and speckled, parietal lamella varying from rather long, with the inner end hardly visible in apertural view, to shorter or reduced, and rather convex whorls. PILSBRY (1901) included them all in the *mumia* group.

For many decades the taxonomy of the genus has been mainly based on conchological characters, resulting in virtually every population along the Cuban coast being described as a new species. Neighbouring populations are known to interbreed, suggesting that some of the nominal species reflect the geographic variation rather than the biological reality (MAYR & ROSEN 1956, MAYR & ASHLOCK 1969, GOULD 1997).

Recent studies in Cuba used techniques of geometric morphometrics to find reliable evidence for the patterns of geographic variation (RODRÍGUEZ-OCHOA 2014, 2015) and for a relationship between the shell shape and the geographical distance, supporting the patterns described by GOULD & PAULL (1977). Here I analyse the morphometrics of the *mumia* group and compare the material with the type specimens in terms of the classical variables of the shell to evaluate the relationships between the taxa in the current classification system.

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MATERIAL AND METHODS

The species was sampled on the north coast of Cuba, after checking the bibliography (Fig. 1). Museum material from the following collections was examined: Smithsonian Institute, Field Museum of Natural History, Florida Museum of Natural History and Museum of Comparative Zoology, Harvard University who supplied valuable pictures of the types from their collections and the Cuban Ecology Institute (Table 1). In all, 207 shells were examined based on photos provided by the collections or on the samples collected by myself. Photos of all the collected shells were taken in situ with a SONY 12.0-megapixel camera, and the snails were released.

The shape description was based on the analysis of all the photographs using TPS 2.0 software which yields coordinated information from a total of 18 landmarks per sample (Fig. 2). The coordinates were subject to Procrustes superposition using PAST 3.0 software (HAMMER et al. 2009), to eliminate the effect of size differences and possible impact of rotation and translation at the time of taking the photograph or in the configuration of the landmarks. Consensus for each species was calculated using TPSRelw v.1.45 (ROHLF 2007) and subject to Principal Component Analysis (JOLLIFFE 2002) to obtain PC-scores for each species and prepare a geometric morphometric matrix.

The following morphological characters for each species (Figs 3–14) were entered into a morphological matrix (Table 2): number of whorls, ribs (0 – absent, 1 – fine, 2 – coarse), distribution along the Cuban island (1 – central eastern Cuba, 2 – western Cuba), shell colour (1 – white, 2 – pale brown, 3 – dark brown), peristome (1 – thin, 2 – thickened), peristome colour (1 – white, 2 – coloured), parietal

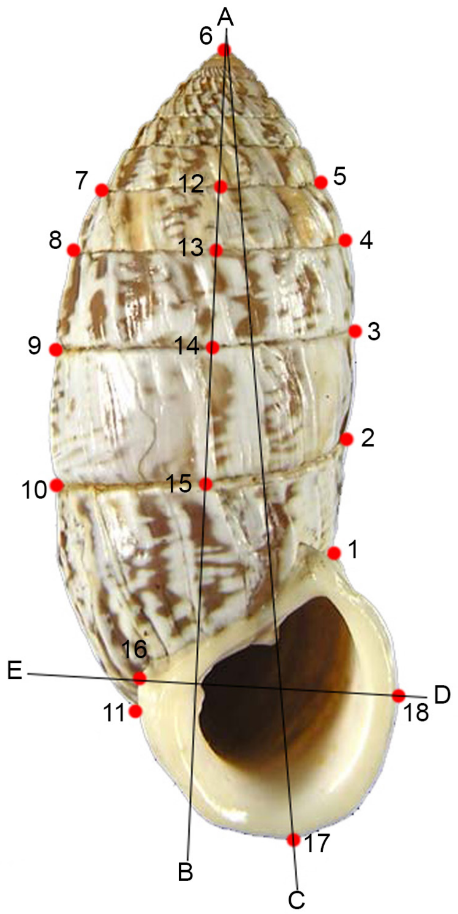


Fig. 2. Schematic representation of the ventral view of *Cerion*´s shell with the location of the 18 landmarks used for the shape description and the geometric morphometric analysis. (A – B midline of the anteroposterior axis of the shell; A – C height; D – E width)

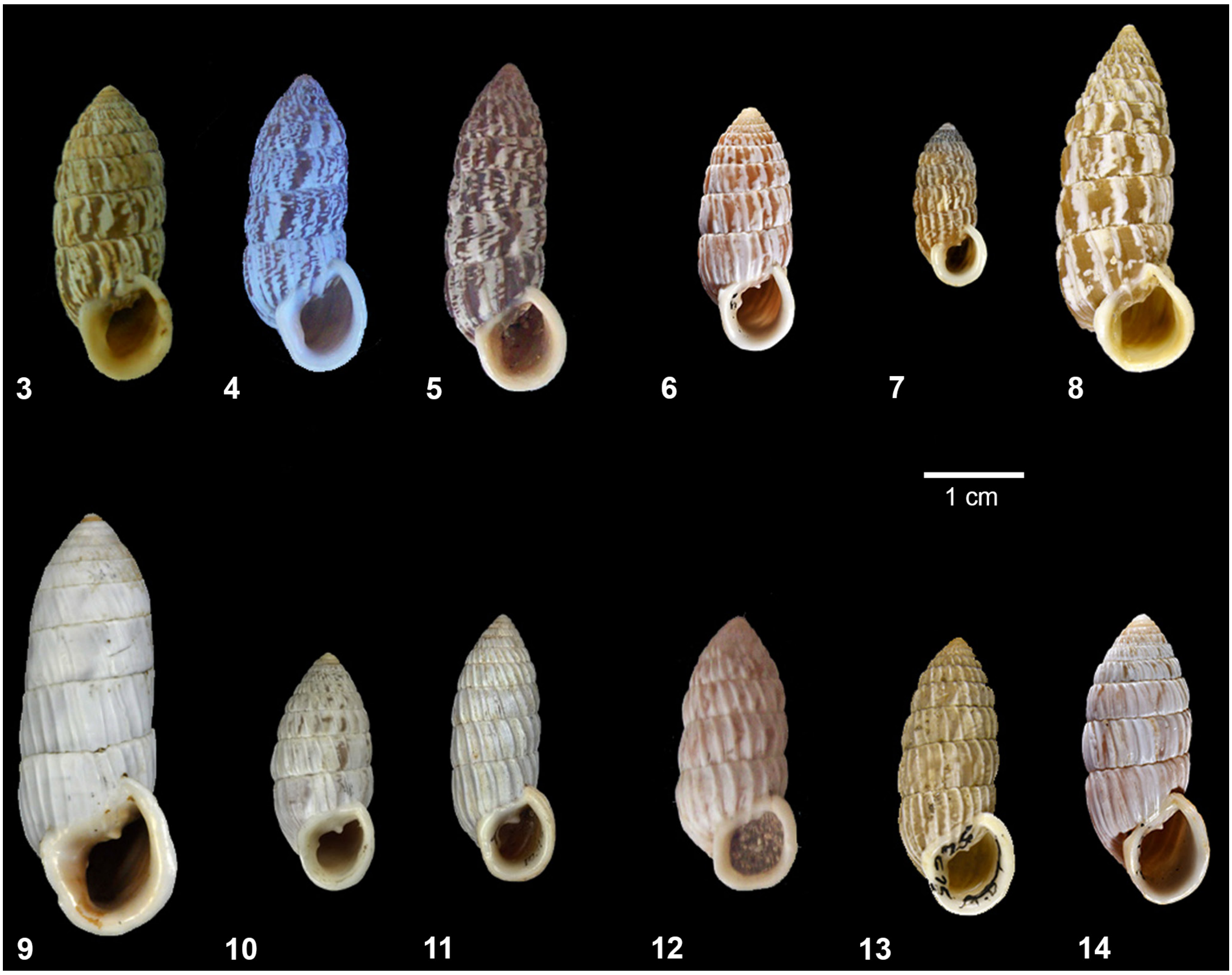
Fig. 1. Type localities and distribution of the species of the *mumia* group: 1 – Puerto Esperanza, Pinar del Río, 2 – Playitas, Bahía Honda, Pinar del Río, 3 – Bahía Honda, Pinar del Río, 4 – Miramar neighbourhood, Havana, 5 – Vedado, Havana, 6 – Playa del Chivo, Cojimar, Havana, 7 – La Noria, Cojimar, Havana, 8 – Matanzas, 9 – Punta Gorda and Punta Sabanilla, Matanzas, 10 – Cárdenas, 11 – Cayo Romano, Camagüey

Table 1. Examined material: taxonomic position, synonyms and distribution of *Cerion mumia* and related species according to: Espinosa & Ortea (1999, 2009), Pilsbry (1901), Pilsbry & Vanatta (1895, 1896, 1898), Clench & Aguayo (1953)

Name	Synonyms	Distribution	Samples	Collection
C. mumia mumia (Bruguière, 1792)	*Pupa mumia* Lamarck, 1819 *Turbo mumia* Wood, 1828 *Helix (Cochlodonta) mumia* Férussac, 1821 *Strophia mumia* (Bruguière, 1792) *Strophia media* Maynard, 1896 *Pupa striata* Schummacher, 1817 *Pupa manica* Deshayes, 1832 *Bulimus mumia* Bruguière, 1792	Miramar, Playa, Havana (4)	46 samples 10 samples MCZ216670	Present study, Club Náutico, La Habana Collections of Ecology and Systematics Institute, Cuba http://invertebrates.si.edu/cerion/index.cfm
C. mumia cabrerai Aguayo et Sánchez Roig, 1953		Cayo Hicacos, NW of Puerto Esperanza, Pinar del Río province (1)	13162 – holotype; 13163	Felipe Poey Museum, Cuba
C. mumia chrysalis (Férussac, 1832)	*Pupa chrysalis* Férussac, 1832 *Pupa chrysalis* Deshayes, 1838 *Pupa capillaris* Beck, 1837 *Strophia chrysalis* Maynard, 1890 *Strophia scripta* Maynard, 1896 *Strophia scripta obliterata* Maynard, 1896 *Strophia fastigata* Maynard, 1896 *Strophia eurystoma* Maynard, 1896 *Strophia eurystoma ignota* Maynard, 1896 *Helix chrysalis* Férussac, 1824	Playa del Chivo, Cojímar, Havana, also in Cárdenas and Matanzas, Matanzas province (6; 10)	55 samples 17 samples MCZ129364	Present study, Playa del Chivo, La Habana Collections of Ecology and Systematics Institute, Cuba http://invertebrates.si.edu/cerion/index.cfm
C. mumia cuspidatum Sánchez Roig, 1951	*Cerion circumscriptum romanoensis* forma cuspidata Aguayo et Sánchez Roig, 1953 *Cerion cuspidata* Aguayo et Sánchez Roig, 1953 *Cerion mumia gigantea* Sánchez Roig, 1951 *Cerion romanoensis* Aguayo et Sánchez Roig, 1953	Cayo Romano, Camagüey (12)	17281 – holotype 42793 FMNH 2 paratypes	Museo Felipe Poey, Cuba Field Museum of Natural History
C. mumia fastigatum (Maynard, 1896)	*Strophia fastigata* Maynard, 1896 *Strophia eurystoma ignota* Maynard, 1896	Vedado, Havana; Cárdenas, Matanzas (5; 9)	MCZ010314 – lectotype 42274 FMNH 6 samples	http://invertebrates.si.edu/cerion/index.cfm Field Museum of Natural History
C. mumia hondanum Pilsbry, 1902		Bahía Honda, Pinar del Río (3)	ANSP25285 – lectotype 56675 FMNH 12 samples	http://invertebrates.si.edu/cerion/index.cfm Field Museum of Natural History
C. mumia noriae Aguayo et Sánchez Roig, 1953		La Noria, Bacuranao beach, Havana (4; 7)	14 samples 15.05/77.840 MNCN 33 samples 13172 – holotype	Present study, Club Náutico, La Habana Present study, Playa del Chivo, La Habana Material deposited at the National Museum of Natural Sciences (MNCN), Spain Museo Felipe Poey, Cuba

Table 1 continued

Name	Synonyms	Distribution	Samples	Collection
C. mumia wrighti Aguayo et Sánchez Roig, 1953		Playitas, West of Bahía Honda, Pinar del Río (2)	13168 – holotype	Museo Felipe Poey, Cuba http://invertebrates.si.edu/cerion/index.cfm
Cerion infandum (Poey, 1858)	*Pupa infanda* Poey, 1858	Punta Gorda and Punta Sabanilla, Matanzas (9)	MCZ76413 – cotype	http://invertebrates.si.edu/cerion/index.cfm
Cerion mumiola (Pfeiffer, 1839)	*Pupa mumiola* Pfeiffer, 1839 *Cerion (Maynardia) mumiola* Pfeiffer, 1839 *Strophia mumiola* Maynard, 1896 *Cerion mumiola* de la Torre, 1954	Matanzas (8)	MCZ72441	http://invertebrates.si.edu/cerion/index.cfm
Cerion sanzi Pilsbry et Vanatta,1898		Nuevitas, North shore of Camaguey, from Cayo Romano to Cayo Guillermo (11)	ANSP11551 – holotype	http://invertebrates.si.edu/cerion/index.cfm



Figs 3–14. Species analysed on this study: 3 – *Cerion mumia mumia*; 4, 5 – *Cerion mumia chrysalis*; 6 – *Cerion mumia cabrerai*; 7 – *Cerion mumiola*; 8 – *Cerion mumia cuspidatum*; 9 – *Cerion infandum*; 10 – *Cerion sanzi*; 11 – *Cerion mumia fastigatum*; 12 – *Cerion mumia noriae* (= *Cerion noriae* comb. nov.); 13 – *Cerion mumia hondanum* (= *Cerion noriae hondanum* comb. nov.); 14 – *Cerion mumia wrighti* (= *Cerion wrighti* comb. nov.)

Table 2. Morphological characters and taxa used in this study

Taxa	Centroid size	Number of whorls	Ribs	Distribution	Shell colour	Peristome	Peristome colour	Parietal teeth	Columellar tooth	Suture	Apical cone
C. alberti (outgroup)	0.589000	5	0	1	1	1	1	0	0	2	0
C. mumia mumia	0.235708	9	1	2	2	2	2	1	1	2	2
C. mumia cabrerai	0.235702	9	1	2	3	1	1	1	2	2	2
C. mumia chrysalis	0.235681	9	1	2	3	1	2	1	1	2	2
C. mumia cuspidatum	0.235598	12	1	1	3	1	1	1	1	2	2
C. mumia fastigatum	0.235923	10	1	2	1	1	2	2	1	2	2
C. mumia hondanum	0.235339	9	1	2	1	1	1	1	1	2	2
C. mumia noriae	0.235712	9	1	2	1	1	1	1	0	2	2
C. mumia wrighti	0.235702	10	1	2	1	1	2	1	0	2	2
C. infandum	0.235752	11	2	2	1	2	2	2	2	1	1
C. sanzi	0.235535	10	1	1	1	1	1	2	2	2	2
C. mumiola	0.235821	9	1	2	3	2	2	1	2	1	2

tooth (0 – absent, 1 – small, 2 – thin and prominent), columellar tooth (0 – absent, 1 – small, 2 – large), suture (1 – shallow, 2 – deep), and apical cone (0 – absent, 1 – poorly developed, 2 – well developed). All the multistate characters were entered in the geometric morphometric matrix which was then subject to Neighbor Joining analysis (Saitou & Nei 1987) with the Euclidean distance as the similarity index and with 5,000 bootstrap replicates. The material from the sampling localities was included in the matrix to check if the programme was useful for species identification and to prevent misidentification of the samples. In the phenogram *Cerion alberti* Clench et Aguayo, 1949 was used as outgroup.

Warp analysis was applied to the consensus, and thin-plate spline graphics was used to illustrate shape variation as deformation of configuration of landmarks on each consensus in relation to the mean shape. The warp scores were subject to principal component analysis (PCA) to evaluate the distribution of the taxa according to their shell shape (Michener & Sokal 1957, Cruz et al. 2012, Borda & Ramirez 2014, Rodríguez-Ochoa 2014).

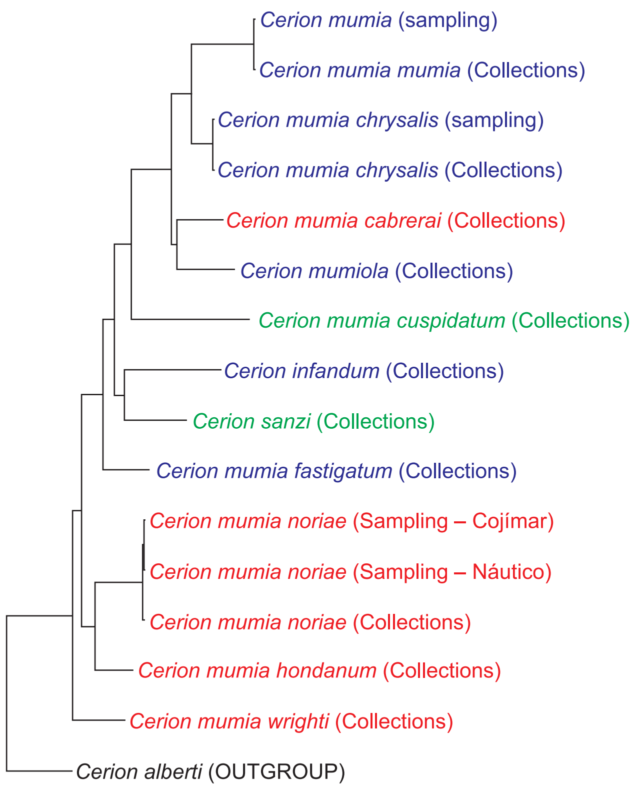


Fig. 15. Neighbour joining clustering of the *Cerion* species based on morphological distances, inferred from 5,000 replicates and generated by PAST 3.0 software (in red taxa from western Cuba, in green taxa from eastern Cuba and in blue taxa from Havana province)

RESULTS

In the phenogram the taxa form two well separated clusters (Fig. 15, for data see: Appendix 1), one with *C. mumia noriae* and *C. mumia hondanum*, the second including the remaining subspecies of *C. mumia* from Havana province and eastern Cuba.

I report a new locality of *C. mumia noriae*, Playa Santa Fe formation, in western Havana, extending its distribution range. The form was described as fossil from the sandstones of El Salado formation in eastern Havana (Clench & Aguayo 1953). Both geological formations date from the late upper Pleistocene.

In all the cases the museum material matches the sampling material showing that the programme was useful for species identification.

The thin-plate spline graphics (Fig. 16) shows that *C. mumia chrysalis*, *C. mumia mumia*, *C. mumia fastigatum* and *C. mumia cuspidatum* tend to have high

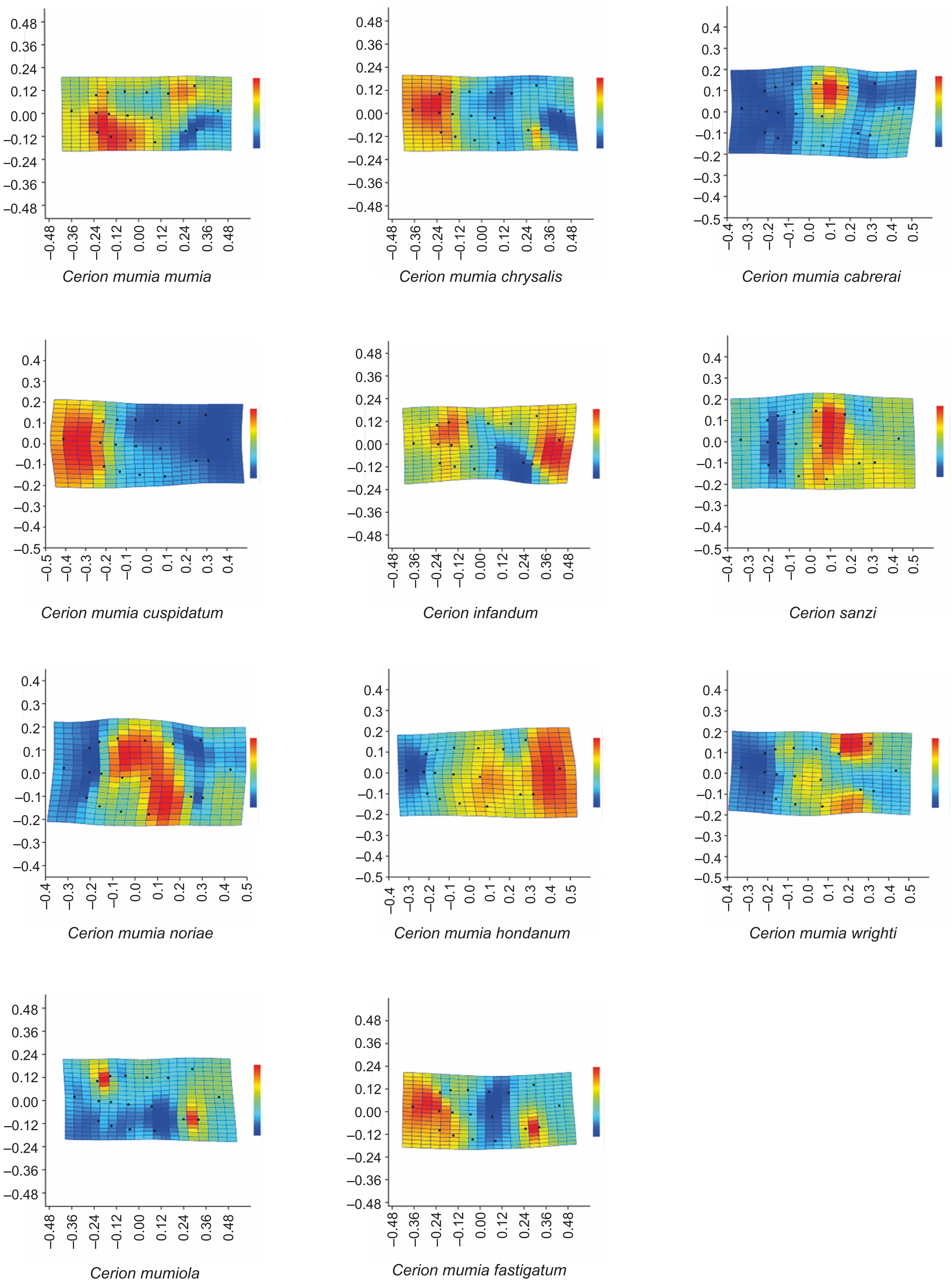


Fig. 16. Thin-plate spline grids; warps in reference to mean shape. Colours indicate expansion (Red) or compression (Blue) factors

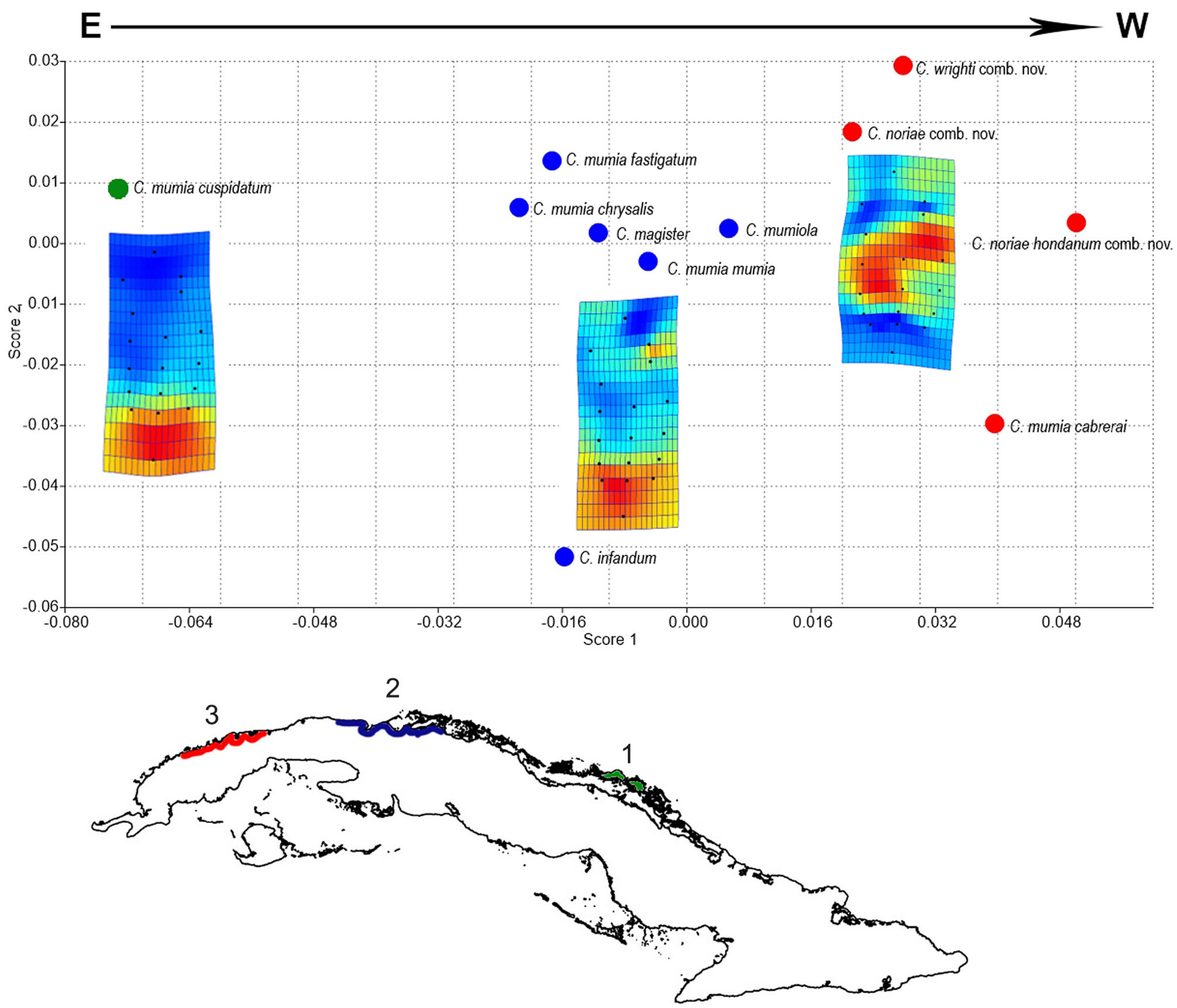


Fig. 17. Plot of the results of principal component analysis (PCA) to the relative warp scores according to the distribution of the taxa along the Island of Cuba, showing distributional pattern according to the shell morphometrics

shells with an apical expansion factor while *C. mumia hondanum* and *C. infandum* tend to have an apertural expansion factor resulting in cylindrical shells with large apertures. The shells of *C. mumia noriae* are more globose with the expansion factor on the last two whorls.

The PCA of the relative warp scores shows a geographical distributional pattern from east to west according to the shell shape (Fig. 17).

DISCUSSION

Cerion shows a great shell shape variation (Figs 3–14). The distribution of its shell shapes – random or presenting a pattern – has been a problem for decades (Gould et al. 1974, Woodruff & Gould 1980, Gould 1997); some authors suggest that the actual number of species in Cuba is smaller than that of the morphotypes (Gould & Paull 1977, Rodríguez-Ochoa 2014).

Our analysis using traditional morphometrics along with geometric morphometrics shows that *C. mumia noriae* should not be regarded as a subspecies of *C. mumia*. According to Aguayo & Sánchez-Roig (1953) "This subspecies (*C. mumia noriae*) is the smallest of the *mumia* group and it is distinguished from the other known races, by not only its smaller size, but by the sharpened form of the axial ribs and by the dimensions of the shell, that are in general

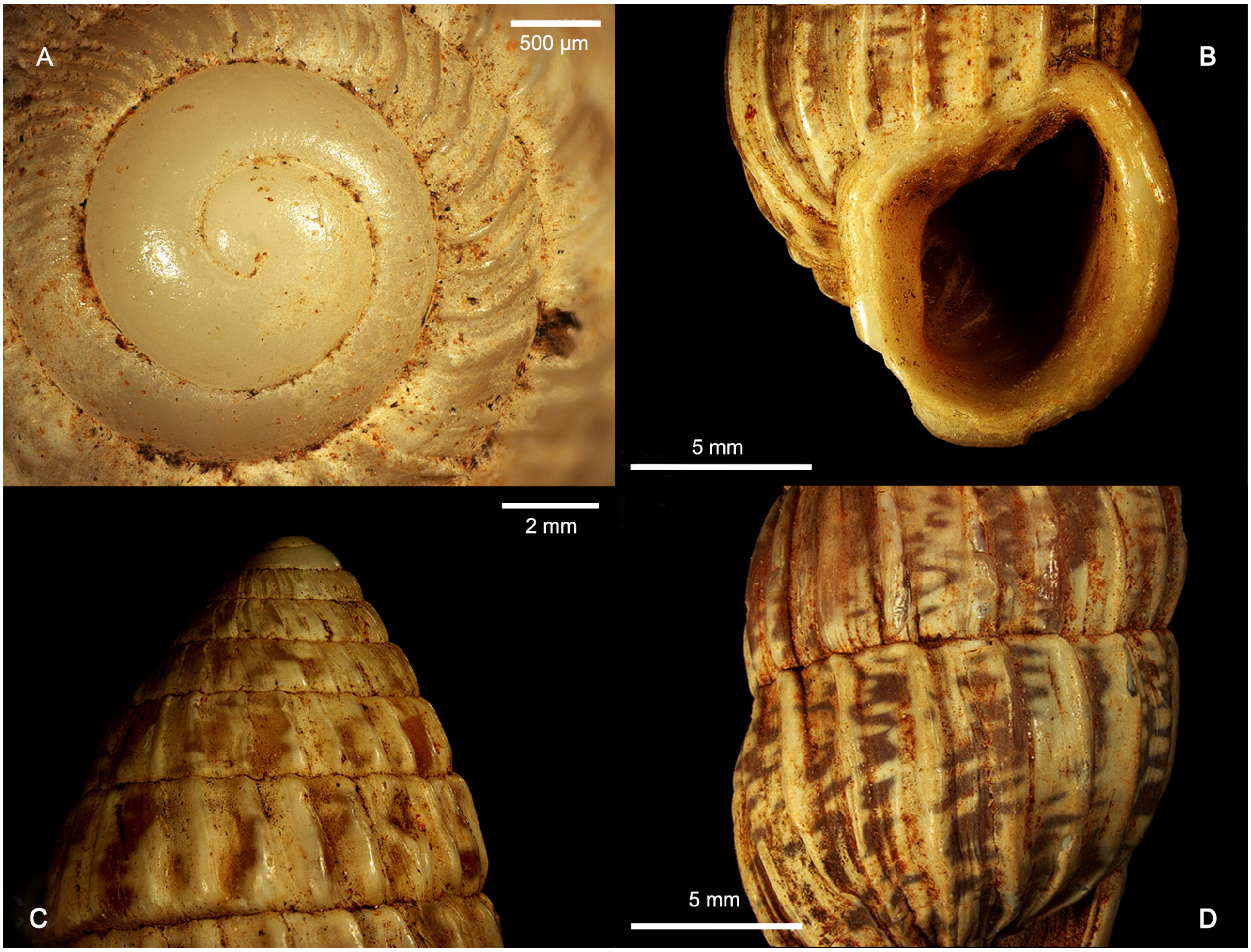


Fig. 18. *Cerion mumia chrysalis*, details of the shell showing the axial brown stripes pattern typical of this species, thinner ribs, and the presence of a small parietal tooth

proportionally wider than those of the other varieties. All the examined specimens were collected in sands or dunes of the region and are in a semifossilised state, lack their proper coloration and are stained of ferruginous salts. Some specimens of a greater size, pertaining to a lot collected by Dr. Pedro J. Bermúdez, show a transition with the smallest specimens of *Cerion mumia scriptum* Maynard, that live in the eastern extremity of Cojímar bay. For that reason, I am inclined to consider this form as a subspecies of *C. mumia* and not as a different species. It shows the same relationship that *Cerion mumiola* Pfr. has with *C. mumiola magister* Pilsbry and Vanatta."

C. mumia scriptum was the name proposed by Maynard as *Strophia scripta* Maynard, 1896 which had been earlier used by Pilsbry & Vanatta (1896) as a synonym of *C. mumia chrysalis*.

Our results suggest that the two taxa are not closely related. While *C. mumia chrysalis* is larger, with the characteristic radial irregular brown streaks and fine ribs (Fig. 18), *C. mumia noriae* has a small white shell with coarse sharpened ribs (Fig. 19). The geometric morphometric analysis revealed also differences in shape: the shell in *C. mumia chrysalis* is high, pointed and cylindrical with the apical expansion factor, while in *C. mumia noriae* it tends to be globose with the expansion factor on the last two whorls. Consequently, I propose to elevate the latter taxon to *Cerion noriae* comb. nov.

In the phenogram *C. mumia hondanum* is the closest to *Cerion noriae* comb. nov. They share the coarse sharpened ribs, small size, and the expansion factor on the aperture and the last two whorls, resulting in globose shells (Fig. 16). The last character is only shared by those two taxa and *C. sanzi*, but considering the particular globose shape of *C. sanzi* and its distribution in central Cuba, it seems likely that *C. mumia hondanum* could be a subspecies of *Cerion noriae* comb. nov. and not of *C. mumia*. Therefore I propose *Cerion noriae hondanum* as comb. nov. It differs from *Cerion noriae* comb. nov. mainly in its shell colour with roughly radial pale brown markings.

C. mumia wrighti occupies a basal position in the phenogram and resembles *Cerion noriae* comb. nov. in

Fig. 19. *Cerion noriae* comb. nov. details of the shell showing the white colour of the shell and coarse sharpened ribs. The dotted surface on the protoconch could result from erosion as this species is only known as fossil. The red colouration is typical of Playa Santa Fe formation deposits

the pale shell colour, coarse ribs, and the shape with the expansion factor on the last whorl rather than *Cerion noriae hondanum* comb. nov. and *Cerion noriae* comb. nov., from which it differs in its larger size and more robust parietal tooth. Considering the differences compared to *Cerion noriae* comb. nov. and the results of morphometric analysis it can be concluded that *C. mumia wrighti* is not a subspecies of *C. mumia*; I propose to elevate it to species rank as *Cerion wrighti* comb. nov.

It is noteworthy that all the subspecies of *C. mumia* share one morphometric character (Fig. 16): the apical expansion factor, resulting in higher, cylindrical shells.

According to the geographical pattern proposed by Rodríguez-Ochoa (2014), species from eastern Cuba tend to have the apical expansion factor while those from western Cuba have the apertual expansion factor. In this study (Fig. 17), despite the limited number of taxa, the pattern is observable which conforms to the western pattern (Pinar del Rio province), with more cylindrical shells with an apical expansion at Havana and more to the east, suggesting a transitional morphospace which could support the allopatric pattern proposed by Woodruff & Gould (1980). The recently proposed zoogeographical history of the whole family Cerionidae based on molecular data supports the idea of colonisation from east to west through the Greater Antilles along the GAARlandia land bridge during the late Eocene to early Oligocene, and later to the Bahamas by stochastic accumulation of hurricane transported propagules (Iturralde-Vinent 2006, Harasewych et al. 2015).

The use of geometric morphometrics in taxonomy and species identification has been well tested (Zelditch et al. 1995, Rohlf 2002, Swiderski et al. 2002, Conde-Padín et al. 2007, Cruz et al. 2012, Rattanawannee et al. 2012, Borda & Ramirez 2014). In our case, the matching of samples with the type specimens proved to be a reliable method of species identification as long as types or reference material are available.

Relationships can also be inferred using morphometric shape variables (Rohlf 2002, Toro et al.

2010). They provide reliable indicators of both taxonomic identity and phylogenetic relationships and are not rife with homoplasy. Some critics argue that shell characters are useless since morphology easily responds to environmental factors being a target of intense selection pressure (SMITH & HENDRICKS 2013). Although shell characters are more prone to homoplastic evolution than anatomical or molecular characters, they can contribute to phylogenetic hypotheses as components of combined analyses increasing the node support and resolution (HERMSEN & HENDRICKS 2008).

Here I used traditional morphometrics and geometric morphometrics to solve incongruences in the taxonomy of the genus *Cerion*.

The directional variation patterns of shell characters in *Cerion* indicate adaptive radiation in which ecological processes are as important as genetic ones. Further studies with the use of molecular data, which are essential for a thorough understanding of the evolution of this genus, will no doubt help to solve the taxonomy and systematic position of this large group in Cuba.

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Appendix 1. Morphological characters and taxa used in this study

	C. mumia mumia	*C. mumia cabrerai*	*C. mumia chrysalis*	*C. mumia fastigatum*	*C. noriae hondanum* comb. nov.	*C. noriae* comb. nov.	*C. wrighti* comb. nov.	*C. infandum*	*C. mumiola*	*C. mumia cuspidatum*	*C. sanzi*	*C. alberti* (outgroup)
X1	0.145	0.187	0.170	0.155	0.168	0.168	0.152	0.168	0.157	0.162	0.169	0.155
Y1	0.100	0.116	0.110	0.099	0.114	0.126	0.093	0.108	0.118	0.102	0.129	0.134
X2	0.056	0.034	0.043	0.049	0.044	0.044	0.040	0.045	0.043	0.054	0.029	0.050
Y2	0.110	0.135	0.128	0.106	0.120	0.141	0.117	0.110	0.120	0.112	0.146	0.168
X3	–0.065	–0.082	–0.081	–0.067	–0.076	–0.077	–0.071	–0.069	–0.071	–0.054	–0.078	–0.068
Y3	0.120	0.132	0.121	0.115	0.121	0.150	0.122	0.116	0.130	0.116	0.140	0.186
X4	–0.156	–0.164	–0.166	–0.161	–0.160	–0.160	–0.163	–0.171	–0.154	–0.144	–0.156	–0.144
Y4	0.118	0.117	0.111	0.114	0.111	0.136	0.116	0.115	0.127	0.116	0.123	0.160
X5	–0.220	–0.217	–0.226	–0.219	–0.216	–0.204	–0.214	–0.235	–0.224	–0.214	–0.206	–0.185
Y5	0.114	0.099	0.093	0.102	0.091	0.109	0.097	0.101	0.102	0.108	0.102	0.114
X6	–0.376	–0.329	–0.341	–0.367	–0.315	–0.318	–0.332	–0.363	–0.346	–0.412	–0.336	–0.262
Y6	0.024	0.016	0.009	0.027	0.012	0.023	0.028	0.005	0.020	0.025	0.010	0.026
X7	–0.218	–0.215	–0.210	–0.221	–0.209	–0.216	–0.219	–0.219	–0.217	–0.210	–0.201	–0.218
Y7	–0.101	–0.097	–0.094	–0.099	–0.098	–0.107	–0.092	–0.101	–0.105	–0.109	–0.109	–0.105
X8	–0.147	–0.152	–0.148	–0.146	–0.147	–0.159	–0.160	–0.138	–0.148	–0.132	–0.144	–0.182
Y8	–0.124	–0.124	–0.120	–0.125	–0.125	–0.143	–0.124	–0.119	–0.131	–0.134	–0.138	–0.165
X9	–0.046	–0.063	–0.046	–0.041	–0.048	–0.063	–0.063	–0.031	–0.049	–0.033	–0.054	–0.091
Y9	–0.140	–0.145	–0.143	–0.147	–0.146	–0.166	–0.149	–0.131	–0.150	–0.148	–0.161	–0.203
X10	0.080	0.068	0.078	0.083	0.087	0.061	0.071	0.094	0.085	0.092	0.081	0.045
Y10	–0.156	–0.159	–0.149	–0.154	–0.160	–0.178	–0.159	–0.140	–0.158	–0.156	–0.176	–0.214
X11	0.322	0.297	0.300	0.323	0.316	0.302	0.325	0.286	0.320	0.307	0.315	0.293
Y11	–0.091	–0.111	–0.108	–0.082	–0.102	–0.107	–0.085	–0.105	–0.099	–0.081	–0.097	–0.123
X12	–0.217	–0.207	–0.218	–0.222	–0.226	–0.203	–0.215	–0.228	–0.215	–0.228	–0.206	–0.186
Y12	0.001	0.003	0.003	0.003	0.006	0.003	0.006	–0.001	–0.003	0.005	–0.002	0.017
X13	–0.144	–0.150	–0.157	–0.151	–0.171	–0.151	–0.156	–0.157	–0.150	–0.152	–0.154	–0.144
Y13	–0.007	–0.004	–0.004	–0.004	0.001	–0.002	–0.005	–0.005	–0.007	–0.003	–0.005	0.010
X14	–0.045	–0.064	–0.060	–0.052	–0.079	–0.057	–0.066	–0.047	–0.056	–0.052	–0.068	–0.057
Y14	–0.018	–0.009	–0.011	–0.015	–0.007	–0.019	–0.013	–0.011	–0.020	–0.011	–0.009	–0.005
X15	0.071	0.062	0.063	0.066	0.052	0.065	0.062	0.084	0.068	0.069	0.050	0.067
Y15	–0.035	–0.020	–0.013	–0.027	–0.018	–0.023	–0.031	–0.017	–0.030	–0.022	–0.018	–0.025
X16	0.241	0.238	0.255	0.248	0.253	0.250	0.261	0.236	0.239	0.248	0.239	0.214
Y16	–0.098	–0.102	–0.095	–0.090	–0.103	–0.102	–0.079	–0.098	–0.096	–0.081	–0.100	–0.103
X17	0.418	0.438	0.437	0.432	0.448	0.425	0.436	0.434	0.429	0.403	0.430	0.408
Y17	0.033	0.018	0.018	0.033	0.022	0.015	0.014	0.022	0.019	0.020	0.015	–0.019
X18	0.301	0.319	0.309	0.292	0.279	0.293	0.310	0.310	0.287	0.295	0.290	0.302
Y18	0.150	0.134	0.145	0.143	0.159	0.142	0.143	0.149	0.164	0.140	0.151	0.147