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MORPHOLOGICAL COMPARISON OF *MELLITA GRANTII* AND *MELLITA LONGIFISSA*

(ECHINODERMATA, ECHINOIDEA, FAMILY SCUTELLIDAE)*

Running Head: Morphology of *Mellita*

por:

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ABSTRACT

Ratios of morphological features of *Mellita grantii* and *Mellita longifissa* are compared using animals collected from the Northern Gulf of California and from Costa Rica.

The two populations of these species can be recognized by differences in the mean value of nine ratios; however, three ratios show no overlap and so would be useful for distinguishing single specimens.

The values for *Mellita grantii* Mortensen 1948 were: length/width ratio 0.91 - 0.99; width/length ratio of lunule 5_I 0.14 - 0.26; lunule 5_I length/total length 0.12 - 0.17.

Mellita longifissa Michelin 1858 for the same measurements had ratios of 0.73 - 0.85; 0.08-0.12; and 0.25 - 0.33 respectively.

RESUMEN

Se estan comparando las facciones morfológicas de Mellita grantii y Mellita longifissa. Para estos fines se comparan unos animales del golfo del norte de California y Costa Rica.

Las dos poblaciones de estas especies puedan ser diferenciadas por medio de nueve diferentes parámetros. Sin embargo, tres parámetros no muestran ningún traslapo y así servirían para distinguir entre los individuos. En Mellita grantii Mortensen 1948 los valores del conciente entre largo y ancho es 0.91 - 0.99; ancho y largo de la lunula 5_I es 0.14 - 0.26; largo de la lunula 5_I y largo total es 0.12 - 0.17.

En Mellita longifissa Michelin 1858 para las mismas dimensiones los valores estaban 0.73-0.85; 0.08-0.12; 7 0.25-0.33 respectivamente.

We have examined populations of sand dollars in the northern Gulf of California since 1969. During our studies of the natural history of two of these species (Ebert and Dexter, 1975) it became apparent that there was a degree of confusion surrounding the identification of species of Mellita viz. whether specimens in the northern Gulf should be assigned to Mellita longifissa Michelin, 1858, or to Mellita grantii Mortensen. 1948.

Mellita grantti was described by Mortensen (1948, 1949) from a single specimen collected by U. S. Grant IV at San Felipe, Baja California (Grant and Hertlein, 1938). Mayr (1954) chose to ignore M. grantii in his analysis of speciation in tropical echinoids because, "From the midst of the range of longifissa Mortensen has described a 'species' M. grantii based on a single specimen..." The latter is of course true but the former is not, because San Felipe is at the northern end of the Gulf and so is at the northern limit of distribution of the genus Mellita in the eastern Pacific basin. Caso (1961) and Brusca (1973) do not mention M. grantii but state that M. longifissa is common in the northern Gulf.

Since Mortensen's original description, Durham (1961) appears to be the only author to recognize M. grantii as being distinct from M. longifissa. His decision was based on material from San Felipe, Ensenada Blanca, and Las Animas Bay.

Clark (1948) assigned two specimens which were collected on the west coast of Baja California to M. longifissa and Durham (1961) records it from western mainland of México as far north as Mazatlán. The southern limit of M. longifissa appears to be Panama (Chesher, 1972).

The purpose of this note is to call attention to the previous literature which relates to Mellita in the Gulf and to present information on morphology which helps distinguish M. grantii from M. longifissa.

MATERIALS AND METHODS

Mellita grantii was collected 2 May 1970 at Playa Hermosa which is between Punta Diggs and Punta Estrella and is approximately 10 kilometers south of San Felipe, Baja California, México (30°55' N; 114°45' W). Mellita longifissa was collected at Playa Cocal, Quepos, Costa Rica (9°26' N; 84°10' W) on 28 February 1971 (Dexter, 1974).

Eleven measurements were made using vernier calipers on 24 Mellita from Quepos and 28 individuals from Playa Hermosa. The measurements are shown in Figure 1. Nine ratios were established using these measurements.

RESULTS AND DISCUSSION

Distribution of the nine ratios and significance of difference between M. longifissa and M. grantii as determined using the Mann-Whitney U-Test are shown in Table 1. A summary of the distribution of ratios is presented in Figure 2, where the ratios of M. grantii are used as a standard and values of M. longifissa are plotted relative to M. grantii. Ratios based on the type specimen of M. grantii are also indicated using values from Mortensen (1948).

Ratio 1 is the total length/total width (e/d) and shows no overlap of the ranges for Mellita from the two locations. The mean ratio for M. grantii is 0.95 and is 0.81 for M. longifissa; M. grantii is rounder than M. longifissa. Clark (1946) states that this ratio is 0.80 - 0.90 for M. longifissa.

Ratio 2, length of lunule I_A/length of lunule 5_I (a/b) shows the greater size difference of lunules in M. grantii than in M. longifissa. The mean ratios are 0.62 and 0.81 respectively. A ratio of 1 would mean that lunule I_A was the same size as lunule 5_I.

COMPARISON OF M. GRANTII AND M. LONGIFISSA

The dimensions of lunule 5_I are shown in ratio 3: lunule 5_I width divided by its length (c/b). This lunule is relatively narrower in M. longifissa than in M. grantii. The mean ratios are 0.10 and 0.17 respectively. Clark (1946) gives this ratio as "less than 0.10" for M. longifissa.

Lunule 5_I is longer relative to test length in M. longifissa than it is in M. grantii. Ratio 4, lunule 5_I length divided by total test length (b/e), is 0.30 for M. longifissa and 0.15 for M. grantii. The range of values for M. longifissa, 0.25 - 0.33, agrees with the range given by Clark (1946) and Grant and Hertline (1938), 0.25 - 0.40.

Ratio 5, height of test divided by test length (g/e) shows a small but highly significant difference between the two species. Mellita grantii is relatively higher with a mean ratio of 0.11. The mean ratio for M. longifissa is 0.10. The distribution of ratios for the individuals in the sample (Table 1) shows that only 2 of the 24 M. longifissa had ratios greater than 0.10; both of these had ratios of 0.12. The z value, using the Mann-Whitney U-Test, is 4.58. The critical z for = 0.001 is 3.30. The difference is highly significant. The type specimen described by Mortensen (1948) has a ratio of 0.14.

Ratio 6 (h/e) describes the relationship of the vertex to the anterior margin of the test. A ratio of 0.50 would mean that the highest point was equidistant between the posterior and anterior margins. The mean ratio for M. grantii is 0.47 and is 0.45 for M. longifissa. The difference is significant at = 0.001 (z=3.56). The vertex is further anterior in M. longifissa than in M. grantii which agrees with Durham (1961).

Ratio 7 (f/e) is similar to Ratio 6. It is the distance from the center of the apical system to the posterior edge of the test divided by the total length of the test. It differs from Ratio 6 because the highest point (the vertex) is not necessarily the center of the apical system. The mean ratio for M. grantii is 0.54 and is 0.56 for M. longifissa The difference is significant at = 0.001 (z = 3.35). The center of the apical system is more anterior in M. longifissa than it is in M. grantii.

Ratios 8 and 9 deal with petal shape. Ratio 8 (j/i) is the width of petal III, divided by its length; the smaller the ratio, the narrower the petal. The mean ratio for M. longifissa is 0.49 and for M. grantii it is 0.44. The difference is significant at 0.001 (z = 3.85). Mellita grantii has petals that are narrower than those of M. longifissa.

Ratio 9 (k/i) is the distance from the apical edge of petal III to the point of maximum diameter of the petal divided by the total length of the petal. A ratio of 0.50 would be obtained from an elliptic or oval shape. The higher the ratio the more distal the displacement of the greatest diameter. Ratios greater than 0.50 would be obovate of oblanceolate. The mean ratio for M. longifissa is 0.42 and for M. grantii it is 0.51. The difference is significant at 0.001 ($z = 4.68$). Petal III is more lanceolate or ovate in M. longifissa than in M. grantii where the petal is elliptic.

Mortensen (1948) describes the outline of M. grantii as nearly round, somewhat higher than M. longifissa with the vertex nearly central. Mellita longifissa is described as wider than long, and truncated; and furthermore that M. grantii has smaller lunules, particularly the posterior interambulacral (5_I).

Although all of the ratios which were calculated were significantly different for the two species of Mellita, not all would be equally useful for distinguishing single individuals from the two samples or from the type specimen of M. grantii (Figure 2). Based only on the samples, ratios 1, 3 and 4 have no overlap of ranges and ratio 2 has only slight overlap. However, the type specimen of M. grantii has a value of 0.88 for ratio 2 which is greater than the mean value for M. longifissa and well outside the range of the 28 M. grantii that were measured. There are at least three possible explanations: the type specimen is atypical, the sample was not representative, or the values used to calculate the ratio were inaccurate. Mortensen does not give the measurements for lunule I_A so we measured it on the plate of the type in his monograph (Mortensen, 1948, pl. LIX). Mortensen also does not provide the measurements of the width of 5_I which is used in ratio 3. He gives length, width and height and the length of 5_I.

Using just ratios 1, 3 and 4, individuals of the two species can be separated by:

1. Length/width ratio 0.91 - 0.99; width/length of lunule 5_I 0.14 - 0.26; lunule 5_I length/total length 0.12 - 0.17. Mellita grantii.
2. Length/width ratio 0.73 - 0.85; width/length of lunule 5_I 0.08 - 0.12; lunule 5_I length/total length 0.25 - 0.33. Mellita longifissa

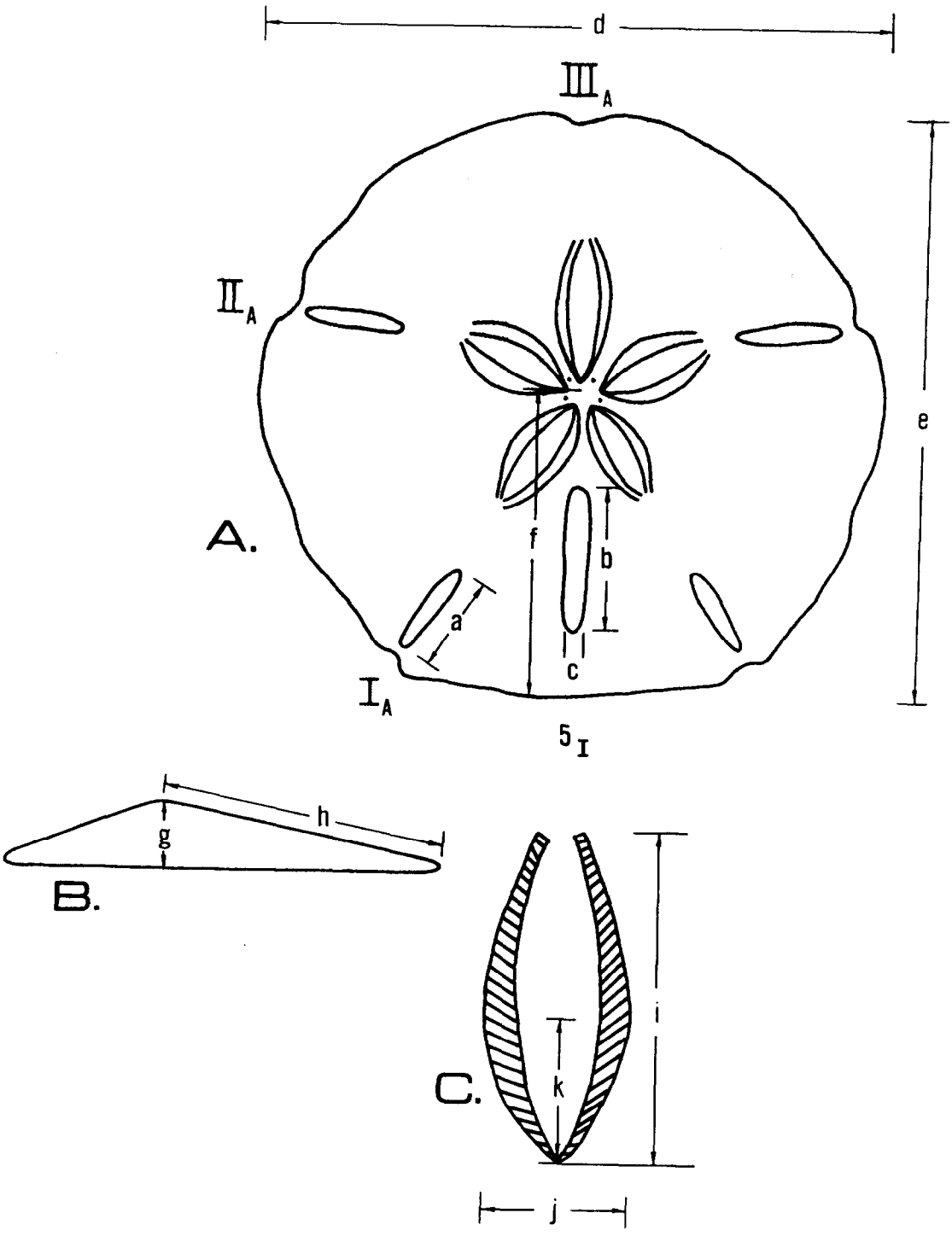

Figure 1. Measurements made on Mellita grantii and Mellita longifissa. A. Aboral view of M. grantii. B. Cross section through III_A and 5_I; g is greatest height and h is distance from vertex to anterior margin (III_A). C. Anterior petal.

Table 1. Distribution and comparison of ratios of selected morphologic features of *Mellita longifissa* from Playa Cocal, Costa Rica and *M. grantii* from Playa Hermosa, Baja California, Mexico. Measurements are shown in Figure 1.

Ratio	Value	Number		*M. longifissa* X	*M. longifissa* SD	*M. grantii* X	*M. grantii* SD	Z
1. length/width (e/d)	.73-.85	24	0					
	.91-.99	0	28					
				.81	.026	.95	.020	6.17
2 length lunule I_A/length lunule 5_I (a/b)	.50-.72	0	27					
	.73	1	1					
	.74-.96	23	0					
				.82	.055	.62	.065	6.16
3 lunule 5_I: width/length (c/b)	.08-.12	24	0					
	.14-.26	0	28					
				.10	.009	.18	.029	6.17
4 5_I length/total length (b/e)	.12-.17	0	28					
	.25-.33	24	0					
				.30	.020	.15	.014	6.17
5 test height/total length (g/e)	.08	4	0					
	.09	6	0					
	.10	12	3					
	.11	0	18					
	.12	2	5					
	.13	0	2					
				.10	.007	.11	.006	4.58
6 vertex to anterior margin/total length (h/e)	.37-.42	3	0					
	.43	1	1					
	.44	6	2					
	.45	6	2					
	.46	4	7					
	.47	4	5					
	.48-.50	0	11					
				.45	.021	.47	.017	3.56
7 center of apical system to post. margin/total length (f/e)	.52	0	1					
	.53	1	5					
	.54	6	11					
	.55	2	8					
	.56	6	2					
	.57	8	0					
	.58	1	1					
				.56	.014	.54	.012	3.27
8 width of petal III/ length of III (j/i)	.37-.41	0	3					
	.42	1	2					
	.43	1	7					
	.44	3	4					
	.45	0	0					
	.46	1	5					
	.47	4	3					
	.48	0	1					
	.49	2	1					
	.50	3	1					
	.51	2	1					
	.52-.60	7	0					
				.49	.048	.44	.031	3.83
9 distance from apical edge of petal III to point fo maximum diameter of III/total length of III (k/l)	.35	1	0					
	.36	0	1					
	.37-.44	15	0					
	.45	3	5					
	.46	2	2					
	.47	1	2					
	.48	1	1					
	.49-.55	0	10					
	.56	1	3					
	.57-.62	0	4					
				.42	.045	.51	.059	4.68

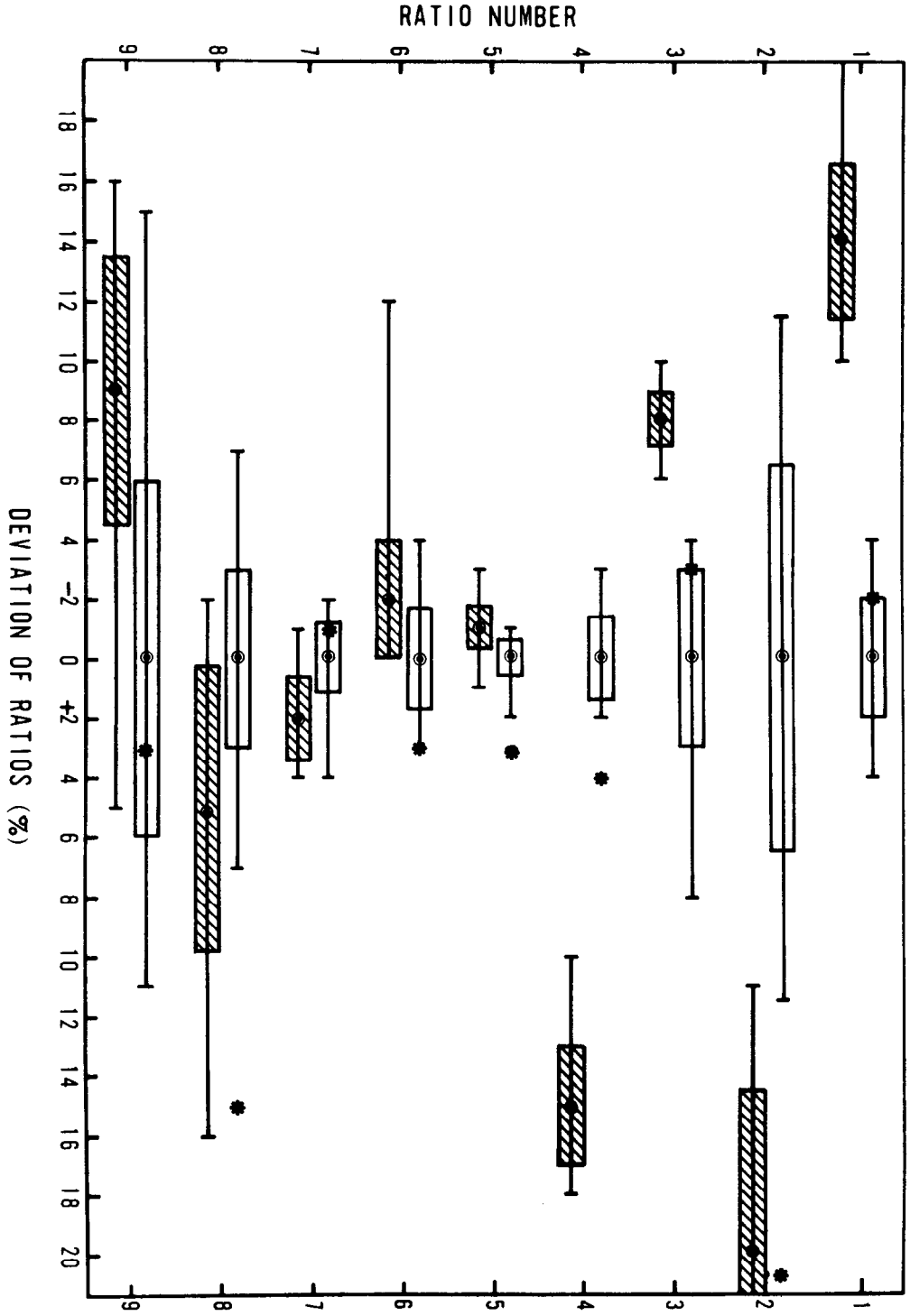

Figure 2. Ratios of morphological features of 28 Mellita grantii from Playa Hermosa, Baja California, Mexico, and 24 Mellita longifissa from Playa Cocal, Quepos, Costa Rica Lines are ranges and bars are one standard deviation on either side of the mean. Open bars are M. grantii which is used as the standard. Mellita longifissa, hatched bars, is plotted relative to M. grantii. The ratios of the type of M. grantii are shown with an asterisk (*).

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