

Supporting Information

Sadowski et al. 10.1073/pnas.1414777111

SI Text

Results of the Cluster Analyses

Cluster Analyses of the Amber Inclusions. Before cluster analyses were performed, it was tested whether the assumptions for cluster analyses, a metric level of measurement and the absence of outliers, were met. The accuracy of data entry, missing values, skewness, and kurtosis were also examined. Five outliers were excluded (Table S1, numbers 9, 28, 62, 73, and 99).

Due to high correlations between the variables stalk length and gland length ($r = 0.6$), it was decided to run the cluster analysis twice, excluding the length of the glandular head in the first run and without the stalk length in the second run.

The four-cluster solution is supported by the increase of η^2 from 0.84 to 0.91 (Table S2). Moreover, the values of η^2 do not increase considerably in the subsequent solution. Hence, the addition of more clusters would not improve the results. Regarding the proportional reduction of error (PRE) coefficient, the value for four clusters is low (0.46) and decreases to 0.28 if another cluster is added, indicating minor improvements for the five-cluster solution. However, the value of F -max is not maximal. The six-cluster solution is supported by the maximal F value and the low PRE (0.26), but the η^2 value does not increase substantially for the solution of six clusters (Table S2).

All in all, the first analysis revealed a clear size pattern for the tentacle morphology: with increasing stalk length the width of the glands, the stalk base width and the tip width rise as well (Table S3).

In the second cluster analysis excluding the stalk length, three- or four-cluster solutions are reasonable (Table S4). The three-cluster solution is supported by the maximal F value as well as by the strong decrease of PRE from 0.55 to 0.38. The increase of η^2 supports the solution of three clusters as well. However, four clusters would be possible, too. The PRE is still very low and η^2 relatively high. Moreover, the four-cluster solution also contains the second largest F value.

As in the first run of the analysis, a size pattern became visible (Table S5), indicating that with longer glands the width of the glands as well as the width of the stalk increased.

Cluster Analyses of *Roridula gorgonias*. The cluster analysis was only applied for *Roridula gorgonias*, because the variables of *R. dentata* were correlated too highly (up to $r = 1$). As in the amber inclusions, the assumptions for cluster analyses (metric level of measurement and the absence of outliers) were tested, as well as the accuracy of data entry, missing values, skewness, and kurtosis. Seven outliers were excluded from the analysis (Table S1, numbers 167, 168, 170, 190, 197, 202, and 206).

Similar to the prior analyses of the amber inclusions, correlations between stalk length and width of the stalk base ($r = 0.85$), stalk length and gland width ($r = 0.80$), as well as gland length and gland width ($r = 0.88$) were again quite high. However, the conduction of the cluster analysis was still reasonable, because these correlations did not exceed $r = 0.9$ and only appeared in three cases. To avoid high correlations and to maintain a good comparability to the cluster analyses of the amber inclusions, the variable gland length was excluded from the first run. As in the amber inclusion, a second cluster analysis was computed, leaving out the stalk length.

The results of the first cluster analysis excluding the gland length (Table S6) revealed two possible solutions: two and five clusters. The solution for two clusters is supported by the PRE value, because it drops strongly from 0.86 to 0.46 and thus indicates that the following cluster solution does not show considerable improvements. However, F -max is not maximal and the change in η^2 from 0.86 to 0.93 is rather small. The maximal F value is the highest for the 10-cluster solution, but with regards to the content not very feasible.

Another possible solution would be five clusters, because the PRE value is low, followed by another decrease, revealing minor improvements if more clusters are added. In this scenario, F -max is not maximal but higher than in the three-cluster solution. However, η^2 does not change substantially (Table S6).

As for the amber inclusions, the mean values of the size classes show that, with increasing stalk length, the width of the stalk and the glands increase, too (Table S7).

In the second run of the cluster analyses (without the variable stalk length), several solutions were indicated (Table S8). The maximal F value speaks for two clusters, but in this case, the relatively high PRE and the very low η^2 do not support this scenario. The three-cluster solution is indicated by the low PRE, which drops considerably from 0.70 to 0.32. However, η^2 does not change substantially and F -max is not maximal. Another possible solution is a four-cluster scenario, because PRE is low and decreases from 0.31 to 0.19. The following PRE values do not change strongly. The F value is not maximal but the second largest. The four-cluster solution is also supported by η^2 , which increases from 0.79 to 0.86 and does not show any considerable changes afterward.

The mean values of the variables (Table S9) indicate a similar morphological pattern as in the amber inclusion: longer glands are broader, and with increasing gland size, the stalk width at the base and the tip increase as well.

Statistical Evaluation of the Fossil and *Roridula gorgonias*. In the first cluster analysis of the amber fossil, the most reasonable solution is the four-cluster result, which is supported by the clear pattern of increasing values in each cluster (Table S3) and by the second run of the analysis without the stalk length, also resulting in four clusters (Tables S4 and S5).

In contrast to the amber inclusions, the most feasible result in the cluster analyses of *Roridula gorgonias* is the five-cluster solution. The two-cluster solution does not appear very likely, because it does not comprise the wide range of the tentacle length from 60 to 3,950 μm .

Although the number of size classes was not the same in the leaf inclusions and *R. gorgonias*, both showed the same pattern of longer tentacles possessing broader stalks and glandular heads. Moreover, it is likely that more size classes were present in the Eocene roridulid plant but are underrepresented in the fossils. In particular, one fossil leaf has a very long tentacle with a ruptured glandular head (Fig. 3A), which was an outlier and hence excluded from the analyses. We see this excluded tentacle as evidence for the additional size class 5.

If the stalk length was excluded from the cluster analyses, the results of the amber fossils and *R. gorgonias* indicated four clusters with the same size pattern: increasing length of the glandular heads is accompanied by rising width of the glandular head and of the tentacle stalk.

Table S1. Measured data (values in μm) from the amber inclusions (group 1) and the leaves of *Roridula gorgonias* (group 2)

No.	Group	Stalk length	Stalk base width	Stalk tip width	Gland length	Gland width
1	1	30	20	10	20	20
2	1	60	20	10	50	30
3	1	90	20	10	60	30
4	1	40	20	10	30	20
5	1	50	20	10	30	20
6	1	40	20	10	40	20
7	1	60	20	10	40	20
8	1	180	40	10	60	30
9	1	1,430	40	10	—	—
10	1	80	20	10	50	20
11	1	80	30	—	50	30
12	1	80	20	10	60	30
13	1	80	30	20	70	30
14	1	60	20	20	50	30
15	1	60	20	10	40	30
16	1	220	40	20	80	40
17	1	70	20	20	50	30
18	1	200	30	10	120	40
19	1	70	20	20	60	30
20	1	40	20	10	30	20
21	1	150	50	20	80	40
22	1	90	20	10	60	20
23	1	60	20	20	50	30
24	1	170	40	20	100	30
25	1	60	20	10	40	20
26	1	70	20	20	50	20
27	1	110	30	20	70	30
28	1	350	20	20	110	30
29	1	70	20	20	50	20
30	1	70	30	10	60	30
31	1	200	40	20	80	30
32	1	90	20	10	50	30
33	1	40	30	20	40	30
34	1	90	30	10	50	30
35	1	130	20	10	50	30
36	1	150	30	20	70	30
37	1	300	50	20	120	30
38	1	60	20	20	50	30
39	1	250	40	20	100	30
40	1	40	30	20	40	30
41	1	60	30	20	60	30
42	1	50	20	10	50	20
43	1	130	30	20	110	30
44	1	200	40	20	70	30
45	1	80	30	20	60	30
46	1	100	20	10	60	30
47	1	250	20	20	110	30
48	1	120	30	20	90	20
49	1	140	30	10	90	20
50	1	60	30	10	80	30
51	1	140	40	30	60	40
52	1	90	30	30	70	30
53	1	110	20	10	50	30
54	1	40	20	20	40	20
55	1	120	20	20	60	20
56	1	70	20	20	60	30
57	1	200	60	20	100	40
58	1	30	20	20	40	20
59	1	100	30	20	110	30
60	1	120	30	30	50	30
61	1	50	20	10	30	20
62	1	300	50	20	60	40

Table S1. Cont.

No.	Group	Stalk length	Stalk base width	Stalk tip width	Gland length	Gland width
63	1	300	50	20	60	30
64	1	50	20	10	40	20
65	1	120	40	20	50	30
66	1	100	30	10	60	30
67	1	190	30	20	80	30
68	1	40	20	10	30	20
69	1	100	30	20	50	20
70	1	140	40	10	70	30
71	1	110	30	10	30	30
72	1	250	40	10	60	30
73	1	110	30	10	120	30
74	1	110	30	10	70	30
75	1	90	30	20	30	20
76	1	40	20	10	30	20
77	1	50	20	10	30	20
78	1	30	20	20	30	20
79	1	200	30	10	70	30
80	1	170	40	20	80	30
81	1	50	20	10	30	20
82	1	40	20	10	30	20
83	1	40	20	20	20	20
84	1	40	10	10	20	10
85	1	40	10	10	30	20
86	1	150	40	20	80	30
87	1	50	30	10	30	30
88	1	100	40	20	50	20
89	1	280	30	10	60	30
90	1	270	40	10	50	30
91	1	20	20	20	20	20
92	1	50	20	10	40	20
93	1	30	20	20	30	30
94	1	80	20	10	60	20
95	1	60	20	10	40	30
96	1	40	20	10	30	20
97	1	140	30	20	50	30
98	1	150	10	10	50	20
99	1	50	50	10	50	20
100	1	160	20	20	60	30
101	1	120	40	10	50	20
102	1	30	10	10	40	20
103	1	110	20	20	50	20
104	2	2,200	120	50	260	120
105	2	1,600	100	40	200	120
106	2	3,000	200	40	220	120
107	2	2,400	120	60	260	120
108	2	3,500	160	60	260	120
109	2	1,400	100	40	200	120
110	2	2,000	100	60	240	120
111	2	2,540	120	40	260	140
112	2	2,500	140	60	240	140
113	2	2,440	140	60	220	120
114	2	3,360	200	60	260	120
115	2	2,000	140	60	240	120
116	2	3,640	180	60	260	120
117	2	2,240	160	60	260	120
118	2	2,300	180	60	240	140
119	2	1,720	120	60	220	120
120	2	2,980	140	60	240	120
121	2	120	50	30	220	140
122	2	200	30	30	100	50
123	2	150	30	30	70	50
124	2	230	50	30	80	50

Table S1. Cont.

No.	Group	Stalk length	Stalk base width	Stalk tip width	Gland length	Gland width
125	2	200	40	30	100	60
126	2	230	40	30	80	50
127	2	450	60	30	90	60
128	2	140	40	30	110	70
129	2	220	50	40	90	40
130	2	170	40	30	90	60
131	2	60	20	15	80	50
132	2	150	40	30	40	20
133	2	310	70	40	70	50
134	2	150	30	40	100	60
135	2	180	50	30	70	50
136	2	150	30	30	80	50
137	2	220	40	30	70	50
138	2	180	40	30	80	50
139	2	110	20	20	80	50
140	2	180	30	30	60	30
141	2	200	40	30	70	50
142	2	100	30	20	70	40
143	2	200	30	30	60	30
144	2	370	50	30	90	50
145	2	120	30	20	120	70
146	2	140	30	30	90	40
147	2	180	40	30	90	50
148	2	700	90	40	90	60
149	2	150	30	20	110	110
150	2	190	40	30	60	50
151	2	200	40	30	90	50
152	2	120	30	30	90	50
153	2	700	70	50	60	40
154	2	300	50	40	130	100
155	2	180	30	20	100	60
156	2	170	40	30	80	40
157	2	1,050	90	50	70	50
158	2	440	70	30	120	120
159	2	230	40	30	110	70
160	2	570	100	40	80	60
161	2	200	30	30	120	70
162	2	250	50	30	70	50
163	2	170	50	50	100	60
164	2	180	50	40	100	70
165	2	300	70	60	90	80
166	2	550	110	80	150	110
167	2	160	50	40	220	190
168	2	490	120	100	80	60
169	2	120	40	40	200	160
170	2	600	150	100	100	70
171	2	240	70	60	200	170
172	2	550	130	90	120	90
173	2	280	80	80	230	180
174	2	550	140	90	130	110
175	2	150	50	40	210	150
176	2	450	100	80	90	60
177	2	150	50	40	180	140
178	2	150	50	40	80	60
179	2	600	140	80	100	80
180	2	250	70	50	200	150
181	2	200	60	50	120	90
182	2	140	40	30	100	90
183	2	130	50	30	70	50
184	2	100	40	30	60	50
185	2	120	30	20	80	60
186	2	150	50	40	70	40

Table S1. Cont.

No.	Group	Stalk length	Stalk base width	Stalk tip width	Gland length	Gland width
187	2	440	100	30	100	60
188	2	170	50	40	90	60
189	2	230	80	40	70	60
190	2	2,300	240	50	200	90
191	2	120	30	20	40	30
192	2	630	120	30	110	70
193	2	180	50	30	70	50
194	2	820	150	40	130	90
195	2	200	50	40	70	50
196	2	120	30	20	50	40
197	2	3,950	250	70	250	130
198	2	220	50	40	70	50
199	2	800	140	50	130	70
200	2	230	60	40	80	60
201	2	420	90	40	100	60
202	2	2,650	250	30	200	90
203	2	500	90	50	120	80
204	2	1,090	150	50	150	80
205	2	100	40	20	50	30
206	2	3,050	270	60	290	120

Table S2. Results of the first cluster analysis of the leaf inclusions, excluding the gland length, with the three statistical test criteria, η^2 , *F*-max, and PRE

Cluster	η^2	<i>F</i> -max	PRE
1	0.00	-99	-99
2	0.69	215.20	0.69
3	0.84	243.19	0.47
4	0.91	321.93	0.46
5	0.94	342.95	0.28
6	0.95	372.49	0.26
7	0.96	351.62	0.12
8	0.96	350.62	0.14
9	0.97	340.66	0.11
10	0.97	326.11	0.08

Indicative values are highlighted in bold.

Table S3. Mean values (in μm) of the four-cluster solution for the leaf inclusions

Variables	Size class 1	Size class 2	Size class 3	Size class 4
Stalk length	49.07	101.79	168.33	265.00
Stalk base width	20.70	27.14	35.56	38.75
Stalk tip width	13.95	15.71	17.22	16.25
Gland width	23.49	26.43	31.11	31.25
No. of tentacles	43	28	18	8

Length of the glandular head is excluded.

Table S4. Results of the second cluster analysis of the leaf inclusions, excluding the stalk length, with the three statistical test criteria, η^2 , F -max, and PRE

Cluster	η^2	F -max	PRE
1	0.00	-99	-99
2	0.55	116.81	0.55
3	0.72	121.61	0.38
4	0.79	117.90	0.25
5	0.82	102.09	0.12
6	0.83	90.92	0.09
7	0.85	84.27	0.09
8	0.86	79.12	0.08
9	0.87	76.20	0.09
10	0.88	73.81	0.08

Indicative values are highlighted in bold.

Table S5. Mean values (in μm) of the four-cluster solution for the leaf inclusions

Variables	Size class 1	Size class 2	Size class 3	Size class 4
Gland length	32.00	53.16	71.58	105.00
Gland width	21.33	26.84	31.58	30.00
Stalk base width	20.00	24.72	26.84	36.00
Stalk tip width	12.33	15.53	17.89	18.00
No. of tentacles	30	38	19	10

Length of the stalk is excluded.

Table S6. Results of the first cluster analysis of *Roridula gorgonias*, excluding the gland length, with the three statistical test criteria, η^2 , F -max, and PRE

Cluster	η^2	F -max	PRE
1	0.00	-99	-99
2	0.86	582.96	0.86
3	0.93	576.90	0.46
4	0.96	781.77	0.49
5	0.98	979.70	0.40
6	0.99	1,090.73	0.28
7	0.99	1,202.36	0.25
8	0.99	1,354.45	0.25
9	0.99	1,458.88	0.20
10	0.99	1,604.54	0.20

Indicative values are highlighted in bold.

Table S7. Mean values (in μm) of the five-cluster solution for *Roridula gorgonias*

Variables	Size class 1	Size class 2	Size class 3	Size class 4	Size class 5
Stalk length	181.15	628.33	1,573.33	2,291.11	3,296
Stalk base width	43.61	107.78	106.67	135.56	176
Stalk tip width	33.52	52.78	46.67	56.67	56
Gland width	66.23	75	120	126.67	120
No. of tentacles	61	18	3	9	5

Length of the glandular head is excluded.

Table S8. Results of the second cluster analysis of *Roridula gorgonias*, excluding the stalk length, with the three statistical test criteria, η^2 , *F*-max, and PRE

Cluster	η^2	<i>F</i> -max	PRE
1	0.00	-99	-99
2	0.70	214.85	0.70
3	0.79	178.59	0.32
4	0.86	184.43	0.31
5	0.88	174.15	0.19
6	0.91	171.12	0.18
7	0.92	168.48	0.15
8	0.93	165.33	0.13
9	0.94	157.11	0.08
10	0.94	154.96	0.10

Indicative values are highlighted in bold.

Table S9. Mean values (in μm) of the four-cluster solution for *Roridula gorgonias*, excluding the stalk length

Variables	Size class 1	Size class 2	Size class 3	Size class 4
Gland length	80.37	114.44	204.44	245.33
Gland width	52.41	81.67	147.78	124.00
Stalk base width	42.41	105.56	67.78	148.00
Stalk tip width	31.20	53.89	46.67	56.67
No. of tentacles	54	18	9	15