Supplementary Information

Mirabilins Revisited: Polyketide Alkaloids from a Southern Australian Marine Sponge, *Clathria* sp.

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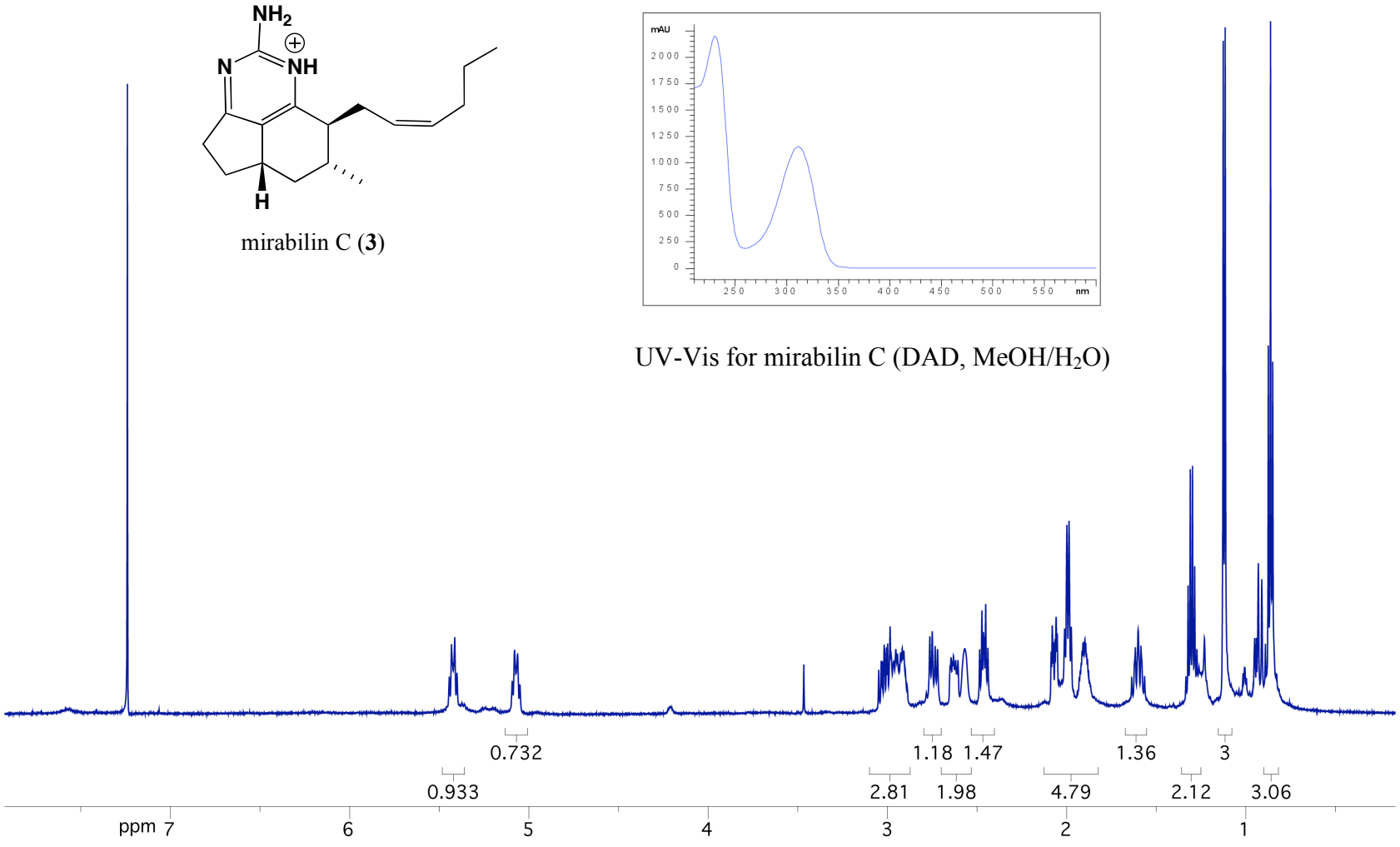
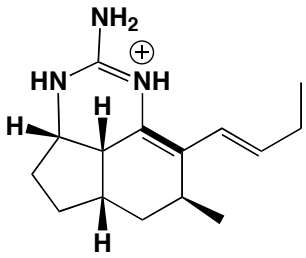
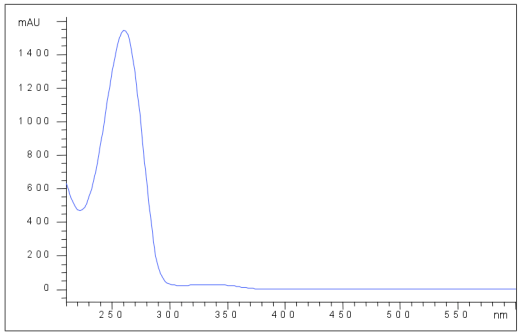


Figure S1: ^{1}H NMR (600 MHz, $CDCl_3$) spectrum for mirabilin C (**3**)

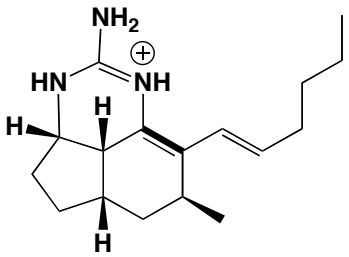


mirabilin F (**17**)

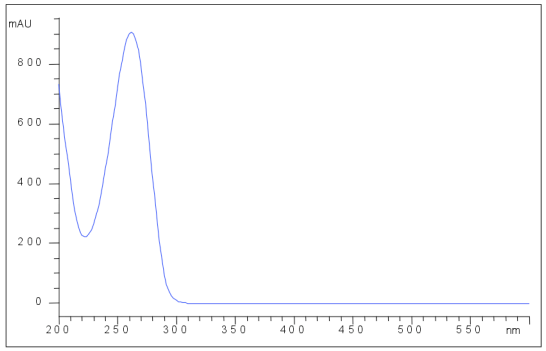


UV-Vis for mirabilin F (DAD, MeOH/H_2O)

Figure S2: ^{1}H NMR (600 MHz, $CDCl_3$) spectrum for mirabilin F (**17**)

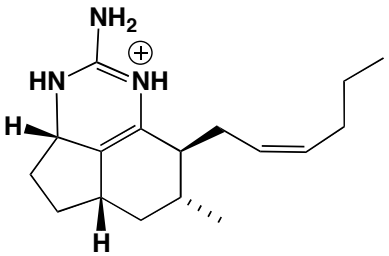


mirabilin G (**16**)

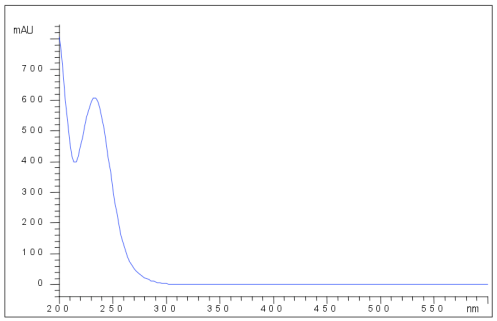


UV-Vis for mirabilin G (DAD, MeOH/H_2O)

Figure S3: ^{1}H NMR (600 MHz, $CDCl_3$) spectrum for mirabilin G (**16**)

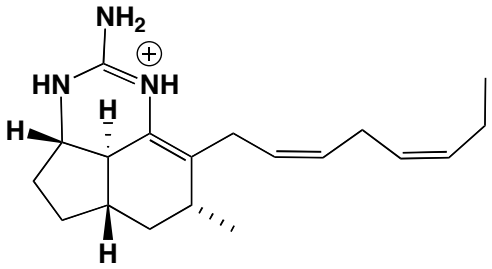


mirabilin H (**22**)

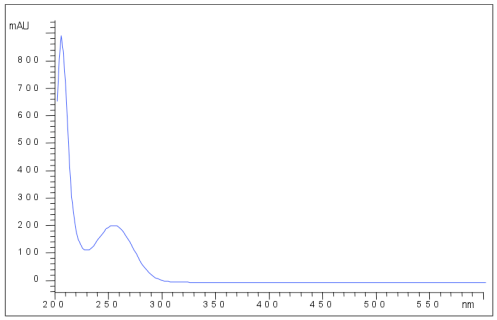


UV-Vis for mirabilin H (DAD, MeOH/H_2O)

Figure S4: ^{1}H NMR (600 MHz, $CDCl_3$) spectrum for mirabilin H (**22**)

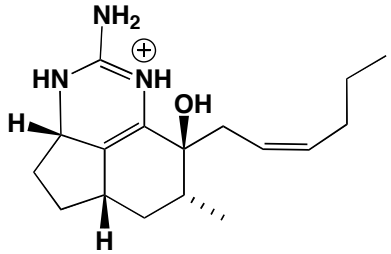


mirabilin I (**23**)

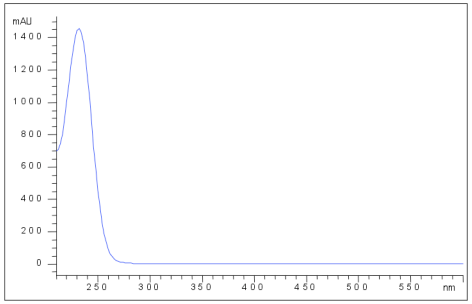


UV-Vis for mirabilin I (DAD, MeOH/H_2O)

Figure S5: ^{1}H NMR (600 MHz, $CDCl_3$) spectrum for mirabilin I (**23**)



mirabilin J (**24**)



UV-Vis for mirabilin J (DAD, MeOH/H_2O)

Figure S6: ^{1}H NMR (600 MHz, $CDCl_3$) spectrum for mirabilin J (**24**)

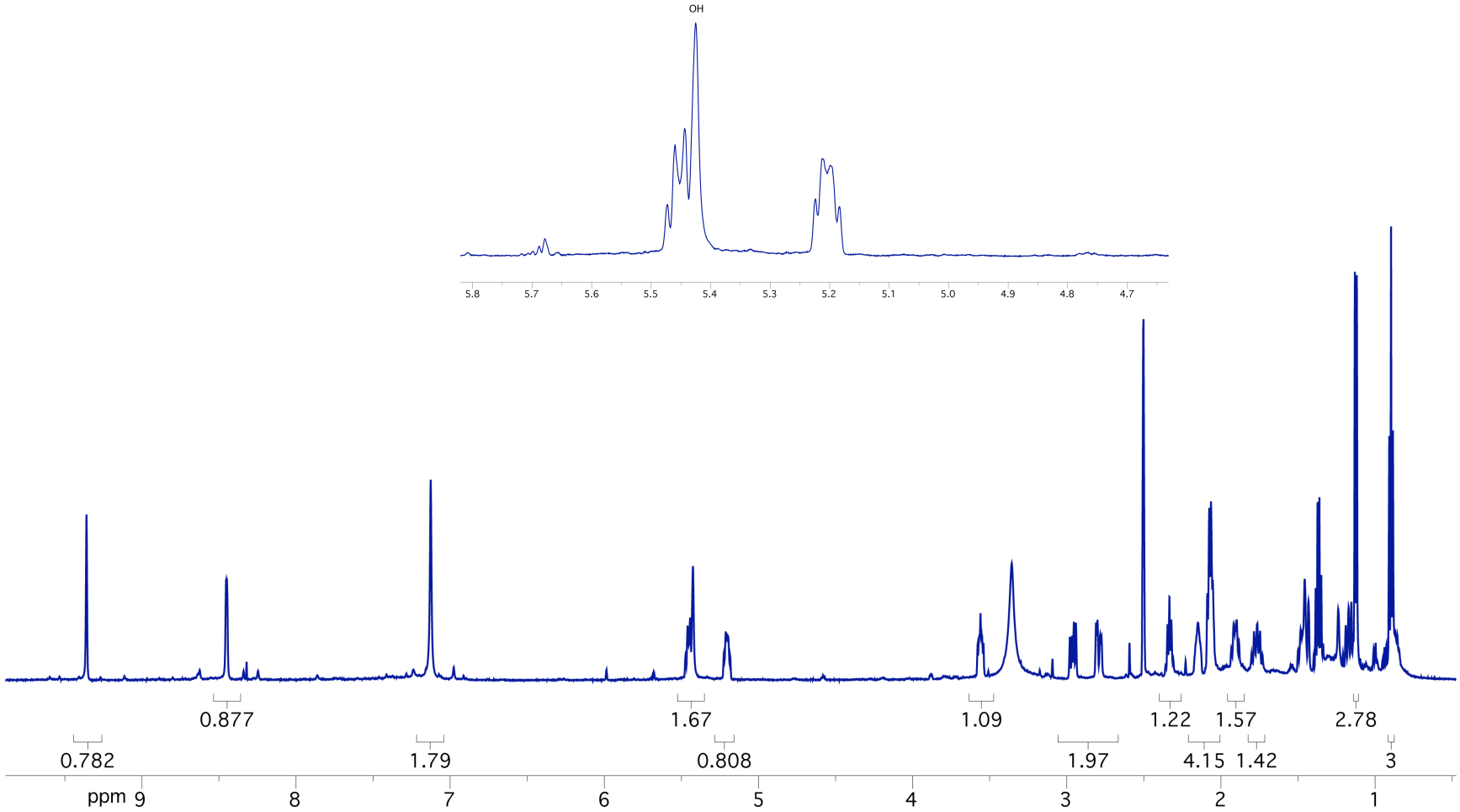


Figure S7: ^{1}H NMR (600 MHz, DMSO-d_6) spectrum for mirabilin J (**24**)

Table S1: 1D and 2D NMR (600 MHz, $CDCl_3$) data for mirabilin C (**3**) and mirabilin C acetate (**3a**) (400 MHz, $CDCl_3$)[1]

	mirabilin C (3)					mirabilin C acetate (3a)	
No.	**δ_C**	**δ_H (mult, *J* Hz)**	**COSY**	**HMBC (^{1}H-^{13}C)**	**ROESY**	**δ_C**	**δ_H (mult, *J* Hz)**
1-NH							
2	158.5					156.8	
2-NH_2							8.01 (s)
3-NH							
4	127.0					175.1	
5a	34.5	3.03 (m)	5b, 6a, 6b			33.7	3.02 (ddd, 17.0, 11.9, 7.4)
5b		2.76 (dd, 8.2, 17.8)	5a, 6b	4, 7			2.71 (dd, 17.0, 8.4)
6a	32.8	2.48 (m)	5a, 6b, H-7	4, 7	6b, 7	33.1	2.40 (ddd, 12.2, 7.4, 7.3)
6b		1.62 (m)	5a, 5b, 6a, H-7		6a		1.58 (dddd, 12.3, 11.9, 10.3, 8.4)
7	37.3	2.93 (m)	6a, 6b, 8a, 8b		6a, 8a, 9	37.8	2.98 (dddd, 12.0, 10.3, 7.3, 4.4)
8a	38.9	2.10 (brt, 4.0)	7, 8b		7	39.0	2.05 (ddd, 12.2, 4.4, 3.1)
		2.07 (brt, 4.0)					
8b		0.95 (m)	7, 8a, 9	7, 9			0.99 (ddd, 12.2, 12.2, 12.0)
9	33.5	1.92 (m)	8b, 10, 9-Me		7	33.6	1.90 (dddq, 12.2, 9.5, 3.1, 6.6)
9-Me	20.5	1.14 (d, 6.8)	9	8, 9, 10	1b′, 10	20.6	1.12 (d, 6.6)
10	44.4	2.59 (m)	1a′, 1b′, 9		9-Me	47.0	2.36 (dddd, 9.5, 4.7, 4.4, 1.5)
11	117.8[a]					171.3	
12	115.9[a]					131.2	
1a′	27.7	2.99 (m)	1b′, 2′, 10			27.6	2.67 (ddd, 14.9, 4.4, 4.4)
1b′		2.65 (m)	1a′, 2′, 10		9-Me		2.86 (ddd, 14.9, 4.9, 4.7)
2′	123.9	5.09 (bdddd, 7.4, 10.9, 7.4)	1a′, 1b′, 3′	1′, 4′		125.7	5.17 (dddt, 10.7, 4.9, 4.7, 2.0)
3′	134.3	5.44 (bdddd, 7.4, 10.9, 7.4)	2′, 4′	1′, 4′, 5′		132.0	5.39 (brdt, 10.7, 7.3
4′	29.6	2.01 (q, 7.4)	3′, 5′	2′, 3′, 5′		29.5	2.03 (brdt, 7.3, 7.2)
5′	22.9	1.32 (dd, 7.4, 14.4)	4′, 6′	3′, 4′		22.8	1.33 (tq,7.2, 7.3)
6′	13.8	0.88 (t, 7.3)	5′	4′, 5′		13.8	0.89 (t,7.3)
2-NHCOCH$_3$						25.1, 175.1	2.52 (s)

Assignments were supported by HSQC, [a] signals are interchangeable.

Table S2: 1D and 2D NMR (600 MHz, $CDCl_3$) data for mirabilin F (**17**) and mirabilin F acetate (**17a**) (400MHz, $CDCl_3$)[1]

	mirabilin F (17)					mirabilin F acetate (17a)	
No.	**δ_C**	**δ_H (mult, *J* Hz)**	**COSY**	**HMBC (^{1}H-^{13}C)**	**NOESY**	**δ_C**	**δ_H (mult, *J* Hz)**
1-NH		9.31 (s)[a]		12	1’		
2	152.3					138.4	
2-NH_2		7.31 (s)					
3-NH		8.53 (s)	4		4		
4	53.7	3.76 (brs)	3-NH, 5a, 5b, 12		5a, 7, 12, 3-NH	59.6	4.31 (ddd, 10.8, 6.6, 6.6)
5a	32.4	1.99 (m)[b]	4, 5b	6, 7	4	25.9	1.61 (brm)
5b		1.49 (m)	4, 5a, 6a, 6b	4			1.85 (m)
6a	26.4[a]	2.16 (m)[c]	5b, 6b		7	30.9	2.10 (brm)
6b		1.73 (m)	5b, 6a, 7				1.76 (m)
7	33.6	2.48 (m)	6b, 8a, 12		4, 6a, 8a, 8b	32.9	2.53 (m)
8a	31.5	1.99 (m)[b]	7, 8b, 9	9-Me	7, 9	31.2	2.10 (brm)
8b		1.64 (m)	8a	11, 12	7, 9		1.86 (dd, 10.3, 10.3)
9	27.9	2.72 (m)	8a, 9-Me	7, 8, 10, 11	8a, 8b, 2’, 9-Me	27.7	2.86 (dq, 7.6, 7.5)
9-Me	22.5	1.18 (d, 7.2)	9	8, 9, 11	8b, 9, 2’	22.9	1.29 (d, 7.6)
10	124.6					133.1	
11	121.5					130.4	
12	37.3	2.57 (m)	4, 7	4, 5, 6, 10, 11	4	36.9	2.66 (dd, 6.6, 6.6)
1′	121.9	6.22 (d, 15.5)	2′	2′, 9, 11	3′, 1-NH	124.1	6.89 (d, 16.1)
2′	135.5	5.71 (dt, 6.4, 15.5)	1′, 3′	4′, 9, 11	3′, 9, 9-Me	133.5	5.76 (dt, 16.1, 6.6)
3′	26.6[a]	2.16 (m)[c]	2′, 4′	1′, 2′, 4′	1′, 2′, 4′	26.7	2.19 (dq, 7.3, 6.6)
4′	13.7	1.01 (t, 7.2)	3′	2′, 3′	3′	13.8	1.03 (t, 7.3)
N3-$\underline{CO}CH_3$						170.1	
N3-$CO\underline{CH_3}$						23.8	2.28 (s)

Assignments were supported by HSQC, [a, b, c] signals are interchangeable.

Table S3: 1D NMR (600 MHz, $CDCl_3$) data for mirabilin G (**16**)[2]

no.	δ_C	δ_H (mult, *J* Hz)
1-NH		9.61 (s)
2	152.3	
2-NH_2		7.50 (s)
3-NH		8.33 (s)
4	53.4	3.79 (dt, 7.6, 6.3)
5	32.3	1.54 (m)
6	26.3	1.74 (m)
7	33.7	2.47 (m)
8β	31.7	2.02 (m)
8α		1.86 (m)
9	27.5	2.73 (dd, 7.2, 7.3)
9-Me	22.5	1.18 (d, 7.2)
10	124.3	
11	121.0	
12	37.2	2.57 (dd, 7.1, 7.6)
1’	123.1	6.50 (d, 15.6)
2’	133.6	5.71 (15.6, 7.2)
3’	33.1	2.24 (dt, 7.2, 6.3)
4’	31.6	1.40 (tt, 6.1, 6.3)
5′	22.3	1.32 (tq, 6.1, 7.2)
6′	14.1	0.90 (t, 7.2)

Assignments were supported by HSQC.

Table S4: 1D and 2D NMR (600 MHz, $CDCl_3$) data for mirabilin H (**22**) and mirabilin I (**23**)

	mirabilin H (**22**)					mirabilin I (**23**)				
Atom	δ_C	δ_H mult.	COSY	HMBC (^{1}H-^{13}C)	NOESY	δ_C	δ_H mult.	COSY	HMBC (^{1}H-^{13}C)	ROESY
1-NH		9.35 s	3-NH	2, 10, 11, 12	10, 2-NH_2, 1′		8.89 s	3-NH	11	1b′
2	154.0					153.7				
2-NH_2		7.40 s			1-NH, 3-NH		7.36 brs			
3-NH		8.22 s	1-NH	2, 4, 12	4, 5b, 2-NH_2		8.26 s	1-NH		4, 5b
4	52.4	4.22[d]	5a, 5b	11, 12	5a, 5b, 7, 3-NH	52.7	4.23[k]	5a, 5b, 12	10, 11	7, 5a, 5b, 3-NH
5a	33.2	2.12[e]	4, 5b, 6a	4, 6, 7, 12	4, 5b	33.0	2.14 m	4, 5b, 6b	4, 7	4
5b		1.69 m	4, 5a, 6b	4, 6	4, 5a, 6b, 3-NH		1.67 m	4, 5a, 6a, 6b	4, 6, 7	4, 3-NH
6a	29.7	1.91 m	5a, 7, 6b	7, 12	6b, 8b	29.5	1.91 m[c]	5b, 6b		
6b		1.24 m	5b, 6a	4, 5, 7, 12	5b, 6a		1.26 m	5a, 5b, 6a, 7	4, 5, 7, 8	
7	36.6	2.36 s	6a, 8a, 8b	11, 12	4, 8a, 8b, 9	36.6	2.38 m[b]	6b, 8a, 8b, 12	5, 12	4, 9
8a	38.7	1.90 m	7, 8b	10, 12	7, 8b, 9-Me	38.8	1.91 m[c]	7, 8b, 9		
8b		0.86 m	7, 8a, 9	6, 9	6a, 7, 8a		0.86[l]	7, 8a, 9	6, 7, 9, 12	
9	32.3	1.59 m	8b, 10, 9-Me		7, 9-Me, 2′	32.8	1.59 m	8a, 8b, 9-Me		7, 1a′
9-Me	19.9	0.99[f]	9	9, 8, 10	8a, 9, 10, 1′, 2′	20.1	1.03[m]	9	9, 8	1a′
10	42.4	1.98[g]	9, 1′		9-Me, 1-NH, 1′, 2′	118.1	--			
11	127.4					127.5	--			
12	117.7					42.5	1.91 m[c]	4, 7		
1′	25.5	2.51 s	10, 2′	9, 10, 11, 2′, 3′	10, 9-Me, 1-NH, 4′					
1a′						25.8	2.50 m	1b′, 2′	2′, 3′	9, 9-Me
1b′							2.40 m[b]	1a′, 2′	11, 2′, 3′	1-NH
2′	124.5	5.21[h]	1′, 3′	1′, 4′	9, 10, 9-Me	124.9	5.26 m[a]	1a′, 1b′, 3′	1′	
3′	132.7	5.44[i]	2′, 4′	1′, 4′, 5′	5′	131.2	5.44[n]	2′, 4′	4′, 5′	4′
4′	29.8	2.02 m	3′, 5′	2′, 3′, 5′, 6′	6′, 1′	25.9	2.79 m	3′, 5′	2′, 3′, 5′, 6′	3′, 5′
5′	22.9	1.34	4′, 6′	3′, 4′, 6′	3′	126.9	5.26 m[a]	4′, 6′	7′	4′
6′	13.9	0.88[a, j]	5′	4′, 5′	4′	132.4	5.38[o]	5′, 7′	4′, 5′	
7′						20.7	2.06 m	6′, 8′		
8′						14.4	0.96[p]	7′	6′, 7′	

[13]C NMR assignments supported by HSQC.[a,b,c] obscured (overlapping); [d] bdd (6.2, 6.2); [e] dd (7.4, 13.2); [f] d (6.6); [g] bd (4.4); [h] bddd (7.4, 10.6, 7.4); [i] bddd (7.5, 9.9, 7.7); [j] t (7.3); [k]dd (6.6, 6.6); [l] ddd (12.3, 10.6, 12.3); [m] d (6.6); [n] bddd (7.3, 10.5, 7.3); [o] bddd (7.1, 10.6, 7.1); [p] t (7.5)

Table S5: 1D and 2D NMR (600 MHz, benzene-d_6) data for mirabilin I (**23**)

no.	δ_C	δ_H (mult, *J* Hz)	COSY	HMBC (^{1}H-^{13}C)	ROESY
1-NH		9.83 s	3-NH		1a′
2	154.5				
2-NH_2		7.95 bs			
3-NH		8.60 s	1-NH		4
4	52.8	3.72 bt (6.2)	5a, 5b, 12	10	3-NH, 5a, 5b, 7
5a	33.1	1.69 m	4, 5b, 6a, 6b		4
5b		1.43 m[a]	4, 5a		4
6a	29.7	1.43 m[a]	5a, 6b, 7		
6b		0.85 m	5a, 6a, 7		
7	36.7	1.87 m	6a, 6b, 8a, 8b		4
8a	38.9	1.43 m[a]	7, 8b		
8b		0.46 ddd (12.1, 10.7, 12.6)	7, 8a		
9	32.9	1.43 m[a]			
9-Me	20.2	0.81 d (6.4)		8, 9, 12	1b′, 12
10	118.0				
11	128.0				
12	42.7	1.79 m	4		1a′, 1b′, 9-Me
1a′	26.0	2.78 m	1b′, 2′		12, 1-NH
1b′		2.53 m	1a′, 2′		12, 2′, 9-Me
2′	125.6	5.41 m	1a′,1b′, 3′		1b′
3′	131.5	5.59 bddd (7.1, 10.7, 7.6)	2′, 4′	1′	4′
4′	26.6	2.93 m	3′, 5′	3′, 5′, 6′	3′
5′	127.8	5.46 m[b]	4′	7′	
6′	132.7	5.46 m[b]	7′	4′	
7′	21.3	2.08 m	6′, 8′	5′, 6′	
8′	14.8	0.97 t (7.5)	7′	6′, 7′	

Assignments were supported by HSQC, [a, b] signals are interchangeable.

Table S6: 1D and 2D NMR (600 MHz, $CDCl_3$) data for mirabilin J (**24**)

	mirabilin J (**24**)				
Atom	δ_C	δ_H mult.	COSY	HMBC (^{1}H-^{13}C)	ROESY
1-NH		9.05 s			1a′, 1b′
2	151.9				
2-NH_2		7.02 s			
3-NH		8.30 s			
4	59.2	3.67 brs	5a, 5b		7
5a	29.6	2.02 m[a]	4, 5b, 6a, 6b		
5b		1.36 m[b]	4, 5a, 6a, 6b		
6a	23.4	1.83 m	5a, 5b, 6b, 7		6b, 7
6b		1.58 m	5a, 5b, 6a, 7		6a, 9-Me
7	40.2	2.29 m	6a, 6b, 8b		4, 6a, 8a, 8b
8a	28.6	2.12 m	8b, 9		7, 8b, 9
8b		1.56 m	7, 8a	7, 10, 9-Me	7, 8a, 9, 9-Me
9	30.8	2.41 m	8a, 9-Me	7, 8, 11, 12, 9-Me	8a, 8b, 1a′, 1b′, 2′, 3′
9-Me	21.6	1.16[c]	9	8, 9,11	6b, 8b, 1a′, 1b′, 2′, 3′, 4′
10	70.3				
11	129.5				
12	122.7				
1a′	27.0	2.96,m	1b′, 2′	11, 12, 2′, 3′	9, 9-Me, 1-NH, 1b′, 2′, 3′, 4′
1b′		2.79 m	1a′, 2′		9, 9-Me, 1-NH, 1a′, 2′, 3′, 4′
2′	125.6	5.12 brs	1a′, 1b′, 3′		9-Me, 1a′, 1b′, 9, 4′, 5′
3′	132.2	5.42 brs	2′, 4′	1′	9-Me, 1a′, 1b′, 9, 5′
4′	29.7	2.02 m[a]	3′, 5′	2′, 3′, 5′, 6′	9-Me, 1a′, 1b′, 2′
5′	22.8	1.36 m[b]	4′, 6′	3′, 4′, 6′	2′, 3′
6′	13.9	0.90[d]	5′	4′, 5′	
7′					
8′					

^{13}C NMR assignments supported by HSQC.[a,b] obscured (interchangeable); [c] d (6.9); [d] t (7.1); [e] dd (4.9, 4.9); [f] d (5.5); [g] t (7.1)

Table S7: 1D and 2D NMR (600 MHz, DMSO-d_6) data for mirabilin J (**24**)

no.	δ_C	δ_H (mult, *J* Hz)	COSY	HMBC (^{1}H-^{13}C)	ROESY
1-NH		9.36 (s)	3-NH	10	1a', 1b', 2', 2-NH_2
2	151.0				
2-NH_2		7.13 (s)			1-NH, 3-NH
3-NH		8.46 (s)	4, 1-NH		4, 2-NH_2
4	58.0	3.56 (m)	5a, 5b, 3-NH	2, 12	5a, 6a, 7, 3-NH
5a	29.2	1.90 (m)	4, 5b, 6a	4	4
5b		1.17 (m)	4, 5a, 6b		
6a	22.9	1.76 (m)	5a, 7		4
6b		1.48 (m)	5b, 7	4	9-Me
7	39.6	2.15 (m)	6a, 6b, 8b		4, 8a, 8b
8a	28.2	2.07 (m)	8b, 9	6, 7, 9, 9-Me	7
8b		1.44 (bd, 14.7)	7, 8a	4, 7, 10, 11, 9-Me	7, 9, 9-Me
9	29.8	2.33 (m)	8a, 9-Me	8, 7, 11, 12, 9-Me	1a', 1b', 2', 3', 8b
9-Me	21.3	1.12 (d, 7.6)	9	4, 8, 9, 11	6b, 8b, 1a', 1b', 2', 3'
10	68.5				
11	125.0				
12	123.8				
1a’	26.3	2.96 (dd, 8.2, 15.7)	1b', 2'	2', 3', 9, 11, 12	2', 3', 4', 9, 9-Me, 1-NH
1b’		2.79 (dd, 5.4, 15.7)	1a', 2'	2', 3', 9, 11, 12	2', 3', 4', 9, 9-Me, 1-NH
2’	126.7	5.20 (bddd, 7.6, 10.1, 7.6)	1a', 1b', 3'	4'	1a', 1b', 4', 9, 9-Me, 1-NH
3’	130.8	5.45 (bddd, 7.6, 10.1, 7.6)	2', 4'	1'	1a', 1b', 4', 5', 9, 9-Me
4’	28.8	2.07 (m)	3', 5'	2', 3', 5', 6'	1a', 1b', 2', 3'
5’	22.2	1.36 (m)	4', 6'	3', 4', 6'	3'
6’	13.8	0.89 (t, 7.3)	5'		
10-OH		5.42 (s)		10, 12	4, 7, 8a

Assignments were supported by HSQC.

Taxonomy

Specimen CMB-02002 was described as follows: Growth form macrobenthic, flabelliform, lamellate (5-10 mm thick); colour in life pale orange; colour on deck beige; texture firm, flexible; surface translucent, lamellate, clathrous; oscules inconspicuous, sunken; spicules megascleres styles 2 size classes occasionally subtylote, curved (250-280 x 10 µm), straight (230-300 x 5 µm); microscleres palmate isochelae (30 µm); ectosome membranous, hispid with tangential, paratangential and occasionally plumose auxillary styles at the surface with points of choanosomal primary spicules protruding through; choanosome a slightly compressed axial skeleton formed by a renieroid reticulation of thick spongin fibres cored by paucispicular tracts of principal styles. Extra-axially the skeleton becomes plumose. Echinating megascleres are absent and the mesohyl matrix contains abundant pigmented collagen and scattered chelae. This specimen was identified as Class: Demospongiae, Order: Poecilosclerida, Family: Microcionidae, Genus: *Clathria* (*Isociella*), and a voucher sample was deposited with Museum Victoria (Reg No. MVF80004).

Molecular modeling

Molecular modeling studies (Chem3D) suggest that such *cis* and *trans* fused ring junction isomers possess comparable energy and that inter atomic distances between H-12 and 9-Me in the *trans*-isomer are acceptable for NOE interactions.

References

1. Barrow, R. A.; Murray, L. M.; Lim, T. K.; Capon, R. J. *Aust. J. Chem.* **1996,** 49, (7), 767-773.
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