

**Massive decline of *Cystoseira abies-marina* forests in  
Gran Canaria Island (Canary Islands, eastern Atlantic)**

José Valdazo, M. Ascensión Rodríguez-Rodríguez, Fernando Espino, Ricardo Haroun,  
Fernando Tuya

Supplementary material

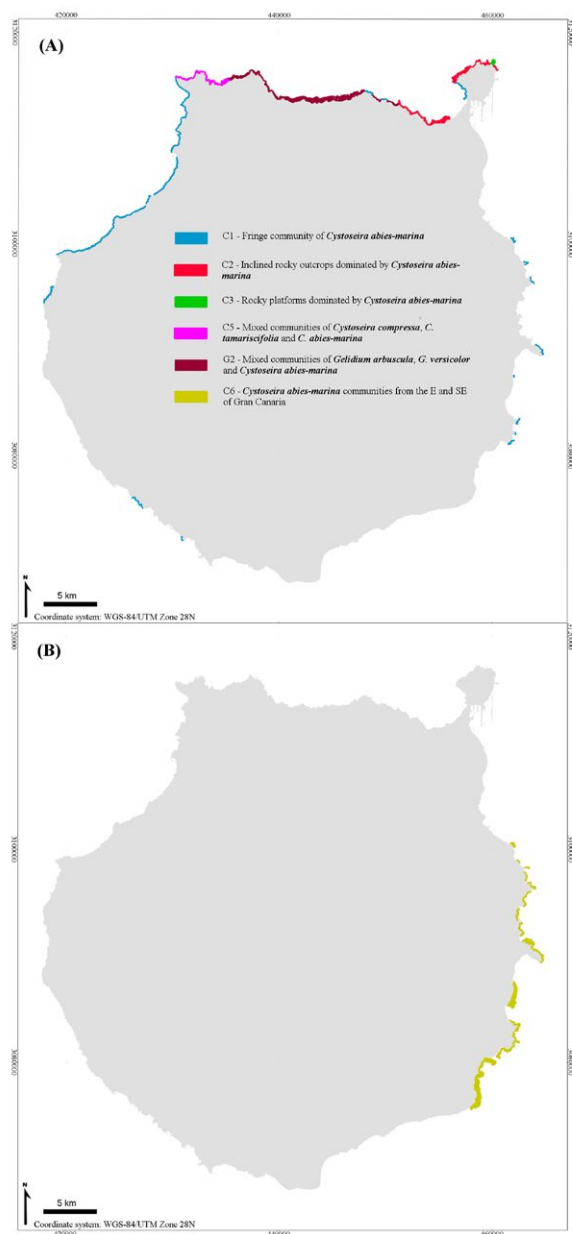


Fig. S1. – *Cystoseira abies-marina* communities in the 1980s, including those from Wildpret et al. (1987) (A) and from oral scientific communications (B).

Table S2. – Types of human pressures, Corine Land Cover (CLC) codes, area and length percentages, and corresponding scores used in calculations of the HAPI index in coastal sectors and populations of Gran Canaria Island.

Types of pressure	CLC code	Area percentage (%)	Score
<b>Continental pressures</b>			
Urban area	11, 14	0-10	1
		11-35	2
		36-75	3
Industrial area	12, 13	>75	4
		0-10	1
		11-25	2
Agricultural area	21-24	26-75	3
		>75	4
		0-5	01
Marine pressures		6-25	12
		16-30	23
		>30	34
<b>Marine pressures</b>			
Coastal artificialization		Length percentage (%)	
		0-5	1
		6-25	2
		26-75	3
Sewage outfall		>75	4
		0-5	1
		6-25	2
Offshore fish farm		26-75	3
		>75	4
		0-1	1
		2-15	2
		16-40	3
		>40	4

Table S1. – *Cystoseira abies-marina*: historical sources (1980s).

Name	Type	Substrate	Slope	Depth	Cover/Abundant	Source
Fringe community of <i>Cystoseira abies-marina</i>	C1	Rocky	80-100%	0-3 m	Continuous belt	Wildpret et al. 1987
Sloping rocky outcrops dominated by <i>Cystoseira abies-marina</i>	C2	Rocky	50-80%	0-9 m	Continuous belt	Wildpret et al. 1987
Rocky platforms dominated by <i>Cystoseira abies-marina</i>	C3	Rocky	0-50%	3-9 m	Continuous belt	Wildpret et al. 1987
Rocky platform mixed communities	C4	Rocky	0-50%	3-9 m	Continuous belt	Wildpret et al. 1987
Mixed communities of <i>Cystoseira compressa</i> , <i>C. tamariscifolia</i> and <i>C. abies-marina</i>	C5	Rocky	0-100%	0-9 m	Continuous belt	Wildpret et al. 1987
Mixed communities of <i>Gelidium arbuscula</i> , <i>G. versicolor</i> and <i>Cystoseira abies-marina</i>	G2	Rocky	70-100%	0-9 m	Continuous belt	Wildpret et al. 1987
<i>Cystoseira abies-marina</i> communities from the E and SE of Gran Canaria	C6	Rocky	0-50%	0-20 m	Continuous belt	Oral scientific communications

Table S3. – Percentages of the area and length of each sector according to human pressure. Pressure scores (PS) assigned to each pressure are indicated. Correlation coefficients ( $R^2$ ) between pressures, turnover score (TS) and the HAPI index ( $HAPI_j = \sum(PS_i \times r_i) / TS_j$ ) were calculated according to Blanfuné et al. 2017.

Sector	Pressure	% Area	% Length	PS	$R^2$	TS	HAPI
1	Urban area	9.35		1	0.14	1.33	3.24
	Industrial area	27.91		3	0.31		
	Agricultural area	0		0	0.06		
	Coastal artificialization		44.74	3	0.68		
	Sewage outfall		43.46	3	0.4		
2	Fish farm		0	0	0.15	1	5.48
	Urban area	72.15		3	0.14		
	Industrial area	21.01		2	0.31		
	Agricultural area	0.04		2	0.06		
	Coastal artificialization		86.66	4	0.68		
3	Sewage outfall		83.03	4	0.4	1	4.09
	Fish farm		0	0	0.15		
	Urban area	28.02		3	0.14		
	Industrial area	24.93		1	0.31		
	Agricultural area	6.77		2	0.06		
4	Coastal artificialization		19.07	3	0.68	1	3.58
	Sewage outfall		49.29	3	0.4		
	Fish farm		0	0	0.15		
	Urban area	25.03		2	0.14		
	Industrial area	18.75		2	0.31		
5	Agricultural area	34.54		2	0.06	1	4
	Coastal artificialization		21.46	2	0.68		
	Sewage outfall		67.63	3	0.4		
	Fish farm		3.77	0	0.15		
	Urban area	25.03		2	0.14		
6	Industrial area	18.75		2	0.31	1	2.81
	Agricultural area	34.54		4	0.06		
	Coastal artificialization		21.46	2	0.68		
	Sewage outfall		67.63	3	0.4		
	Fish farm		6.77	2	0.15		
7	Urban area	2.1		1	0.14	1	0.83
	Industrial area	28.07		3	0.31		
	Agricultural area	41.16		4	0.06		
	Coastal artificialization		0	0	0.68		
	Sewage outfall		34.56	3	0.4		
8	Fish farm		7.09	2	0.15	1	4.55
	Urban area	10.31		2	0.14		
	Industrial area	7.59		1	0.31		
	Agricultural area	40.97		4	0.06		
	Coastal artificialization		0	0	0.68		
9	Sewage outfall		0	0	0.4	1	4.85
	Fish farm		0	0	0.15		
	Urban area	6.71		1	0.14		
	Industrial area	32.66		3	0.31		
	Agricultural area	31.55		4	0.06		
10	Coastal artificialization		36.18	3	0.68	1	3.13
	Sewage outfall		47.73	3	0.4		
	Fish farm		0	0	0.15		
	Urban area	4.4		1	0.14		
	Industrial area	28.19		3	0.31		
11	Agricultural area	50.86		4	0.06	0.8	4.09
	Coastal artificialization		34.83	3	0.68		
	Sewage outfall		32.88	3	0.4		
	Fish farm		13.57	2	0.15		
	Urban area	2.02		1	0.14		
12	Industrial area	9.11		1	0.31	0.8	4.19
	Agricultural area	12.61		2	0.06		
	Coastal artificialization		20.79	2	0.68		
	Sewage outfall		48.75	3	0.4		
	Fish farm		0	0	0.15		
12	Urban area	11.13		2	0.14	0.8	4.19
	Industrial area	0.84		1	0.31		
	Agricultural area	6.78		2	0.06		
	Coastal artificialization		20.171	2	0.68		
	Sewage outfall		68.83	3	0.4		
12	Fish farm		0	0	0.15	0.8	4.19
	Urban area	59.95		3	0.14		
	Industrial area	4.9		1	0.31		
	Agricultural area	0.93		1	0.06		
	Coastal artificialization		12.06	2	0.68		
12	Sewage outfall		29.12	3	0.4	0.8	4.19
	Fish farm		0	0	0.15		

Table S3 (Cont.). – Percentages of the area and length of each sector according to human pressure. Pressure scores (PS) assigned to each pressure are indicated. Correlation coefficients ( $R^2$ ) between pressures, turnover score (TS) and the HAPI index ( $HAPI_j = \sum(PS_i \times r_i) / TS_j$ ) were calculated according to Blanfuné et al. 2017.

Sector	Pressure	% Area	% Length	PS	$R^2$	TS	HAPI
13	Urban area	8.28		1	0.14	0.8	3.83
	Industrial area	0.75		1	0.31		
	Agricultural area	58.21		3	0.06		
	Coastal artificialization		32.74	3	0.68		
	Sewage outfall		5.87	1	0.4		
	Fish farm		0	0	0.15		
14	Urban area	17.86		2	0.14	0.8	4.09
	Industrial area	7.29		1	0.31		
	Agricultural area	10.72		2	0.06		
	Coastal artificialization		14.05	2	0.68		
	Sewage outfall		71.96	3	0.4		
	Fish farm		0	0	0.15		
15	Urban area	12.97		2	0.14	0.8	4.44
	Industrial area	0.6		1	0.31		
	Agricultural area	0		0	0.06		
	Coastal artificialization		23	2	0.68		
	Sewage outfall		75.59	4	0.4		
	Fish farm		0	0	0.15		
16	Urban area	1.72		1	0.14	0.8	4.37
	Industrial area	0		0	0.31		
	Agricultural area	11.71		2	0.06		
	Coastal artificialization		29.74	3	0.68		
	Sewage outfall		33.16	3	0.4		
	Fish farm		0	0	0.15		
17	Urban area	0		0	0.14	0.8	0.075
	Industrial area	0		0	0.31		
	Agricultural area	5.67		1	0.06		
	Coastal artificialization		0	0	0.68		
	Sewage outfall		0	0	0.4		
	Fish farm		0	0	0.15		
18	Urban area	0		0	0.14	1	0.06
	Industrial area	0		0	0.31		
	Agricultural area	4.3		1	0.06		
	Coastal artificialization		0	0	0.68		
	Sewage outfall		0	0	0.4		
	Fish farm		0	0	0.15		
19	Urban area	0		0	0.14	1	0.06
	Industrial area	0		0	0.31		
	Agricultural area	4.37		1	0.06		
	Coastal artificialization		0	0	0.68		
	Sewage outfall		0	0	0.4		
	Fish farm		0	0	0.15		
20	Urban area	2.34		1	0.14	1	1.8
	Industrial area	0		0	0.31		
	Agricultural area	22.39		3	0.06		
	Coastal artificialization		3.56	1	0.68		
	Sewage outfall		11.13	2	0.4		
	Fish farm		0	0	0.15		
21	Urban area	0		0	0.14	1.33	0.045
	Industrial area	0		0	0.31		
	Agricultural area	1.17		1	0.06		
	Coastal artificialization		0	0	0.68		
	Sewage outfall		0	0	0.4		
	Fish farm		0	0	0.15		
22	Urban area	0		0	0.14	1.33	0.044
	Industrial area	0		0	0.31		
	Agricultural area	2.07		1	0.06		
	Coastal artificialization		0	0	0.68		
	Sewage outfall		0	0	0.4		
	Fish farm		0	0	0.15		
23	Urban area	7.1		1	0.14	1.33	2.44
	Industrial area	3.16		1	0.31		
	Agricultural area	47.59		4	0.06		
	Coastal artificialization		0	2	0.68		
	Sewage outfall		0	3	0.4		
	Fish farm		0	0	0.15		
24	Urban area	10.44		1	0.14	1.33	1.93
	Industrial area	10.71		1	0.31		
	Agricultural area	41.45		4	0.06		
	Coastal artificialization		4.15	1	0.68		
	Sewage outfall		41.74	3	0.4		
	Fish farm		0	0	0.15		

Table S3 (Cont.). – Percentages of the area and length of each sector according to human pressure. Pressure scores (PS) assigned to each pressure are indicated. Correlation coefficients ( $R^2$ ) between pressures, turnover score (TS) and the HAPI index ( $HAPI_j = \sum(PS_i \times r_i) / TS_j$ ) were calculated according to Blanfuné et al. 2017.

Sector	Pressure	% Area	% Length	PS	$R^2$	TS	HAPI
25	Urban area	14.98		2	0.14	1.33	1.53
	Industrial area	0.84		1	0.31		
	Agricultural area	59.7		4	0.06		
	Coastal artificialization		0	0	0.68		
	Sewage outfall		45.91	3	0.4		
	Fish farm		0	0	0.15		
26	Urban area	5.33		1	0.14	1.33	1.42
	Industrial area	1.22		1	0.31		
	Agricultural area	39.31		4	0.06		
	Coastal artificialization		0	0	0.68		
	Sewage outfall		62.18	3	0.4		
	Fish farm		0	0	0.15		
27	Urban area	14.55		2	0.14	1.33	2.55
	Industrial area	0.48		1	0.31		
	Agricultural area	45.37		4	0.06		
	Coastal artificialization		9.99	2	0.68		
	Sewage outfall		67.61	3	0.4		
	Fish farm		0	0	0.15		
28	Urban area	13.44		2	0.14	1.33	1.52
	Industrial area	5.98		1	0.31		
	Agricultural area	41.59		4	0.06		
	Coastal artificialization		0	0	0.68		
	Sewage outfall		42.19	3	0.4		
	Fish farm		0	0	0.15		