

Mémoire

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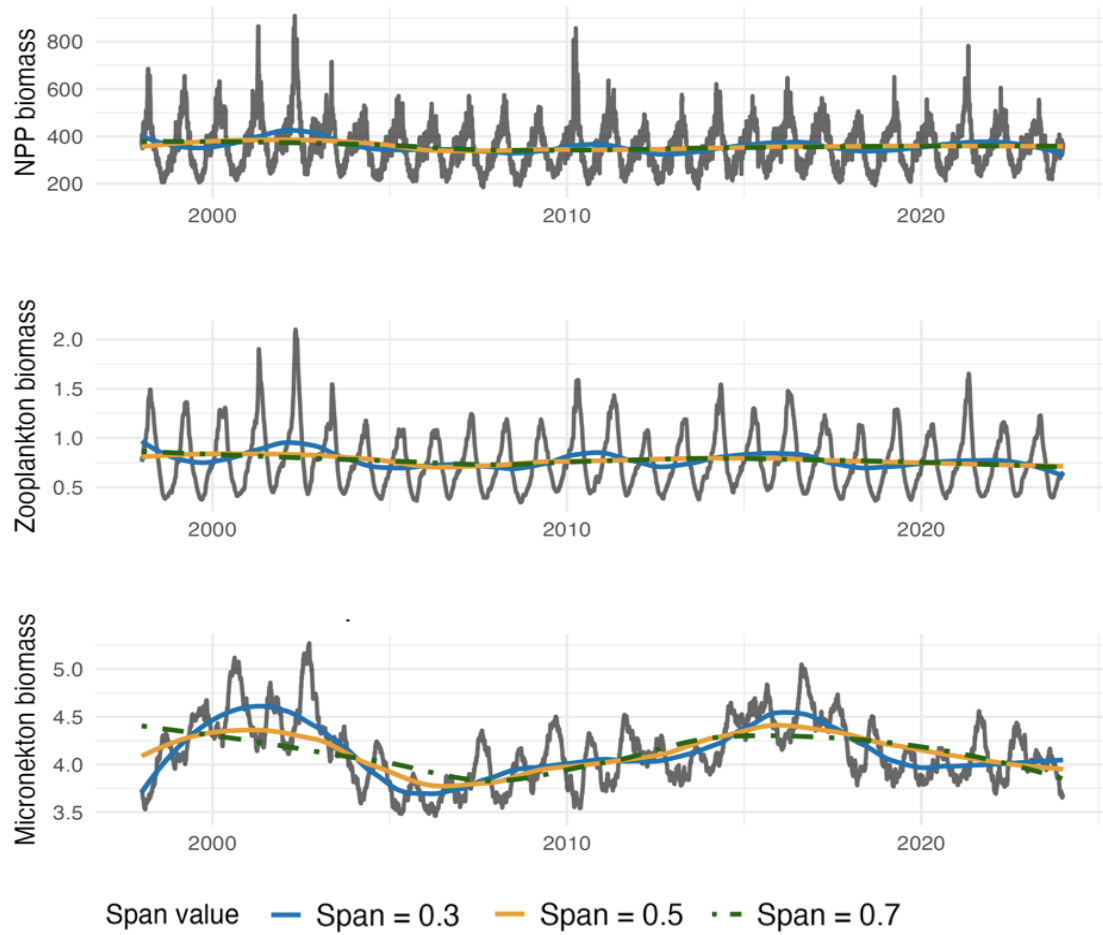


Figure A.1: Plot of the different LOESS span tested for NPP, zooplankton and micronekton. *Blue:* span=0.3; *Orange:* span=0.5; *Green:* span=0.7

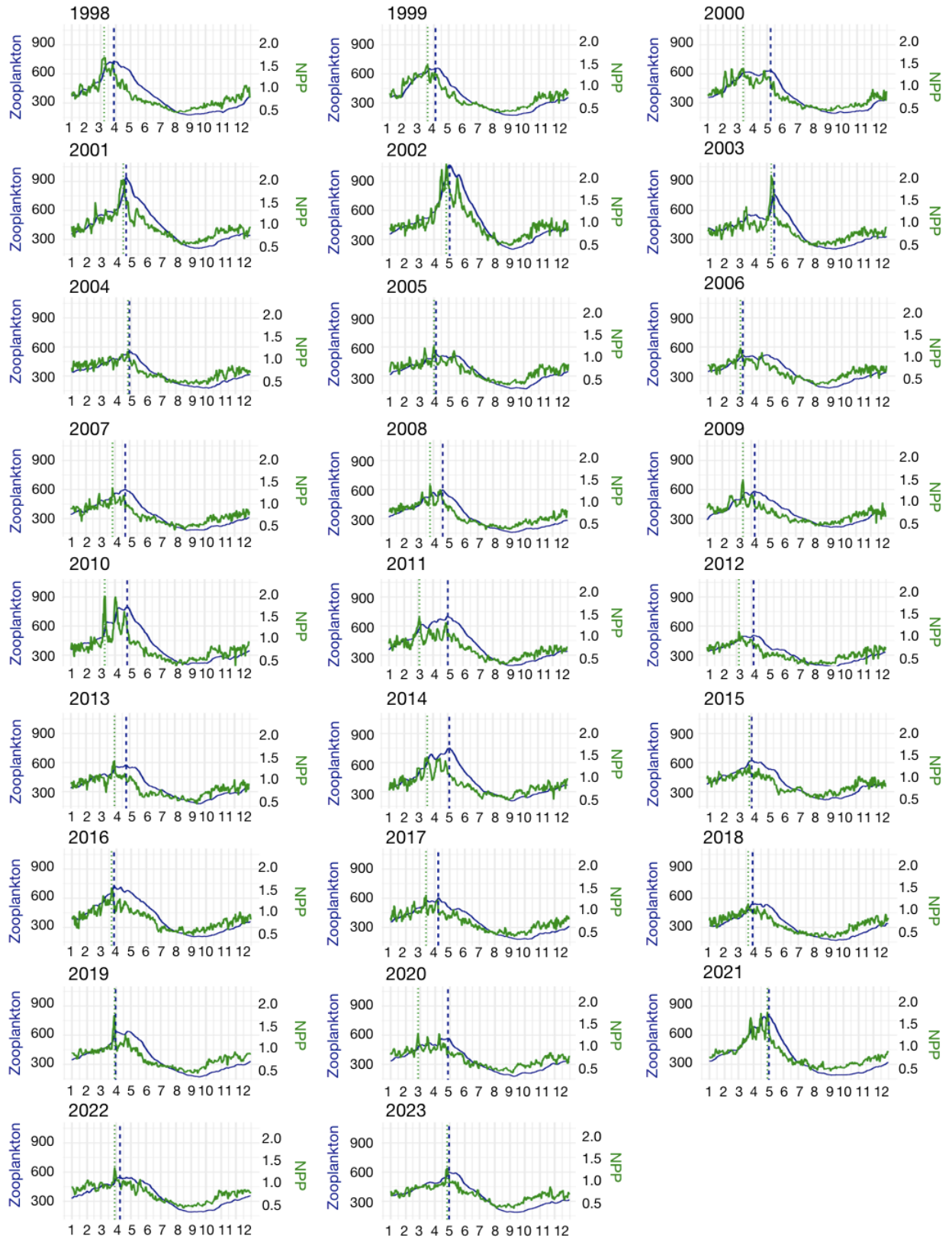


Figure A.2: Time-lag between NPP (Green) and zooplankton (Blue) blooms sfrom 1998 to 2023.

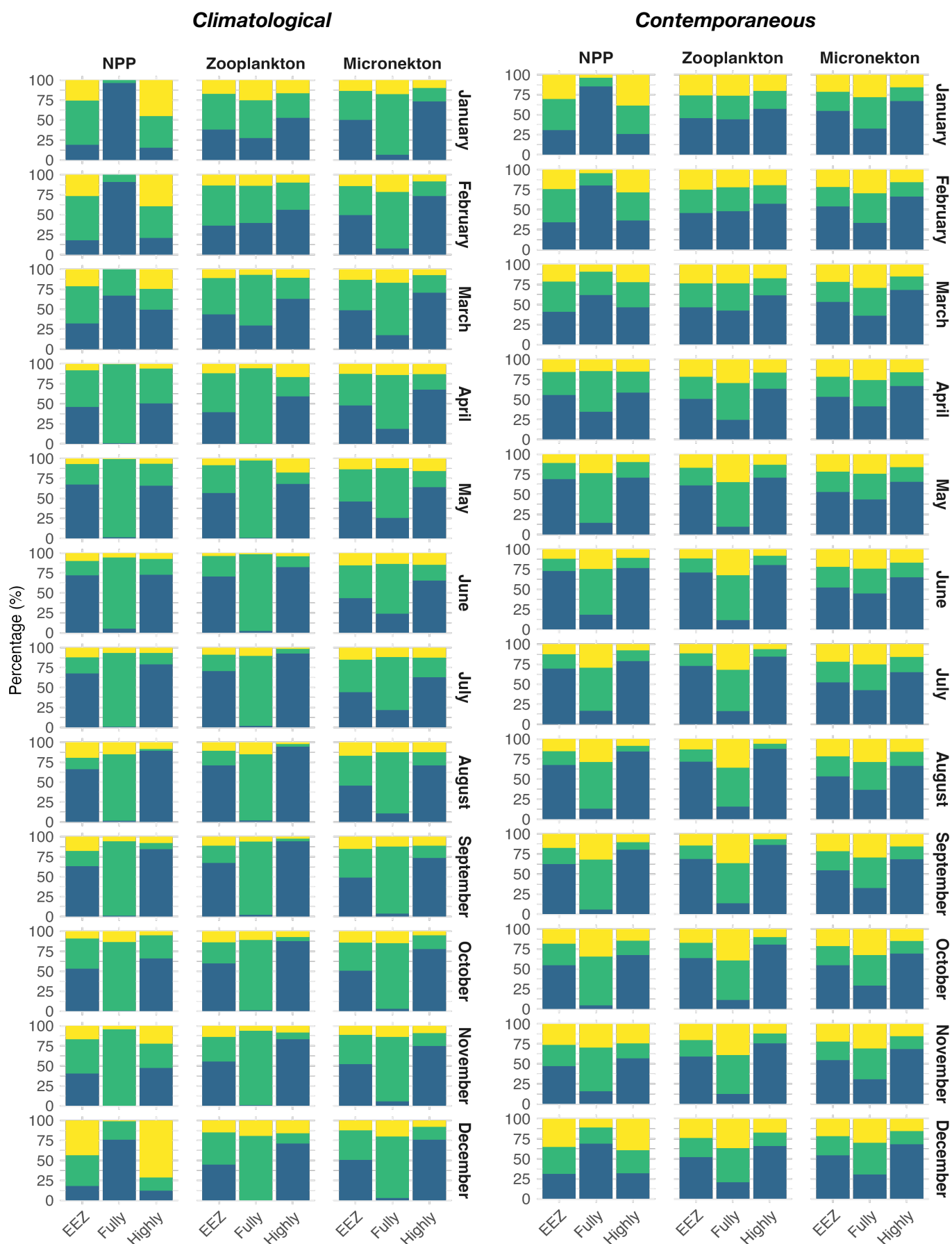


Figure A.3 : Proportion of each productivity zone inside the EEZ and its MPAs, per month for the climatological and contemporaneous study. *Yellow*: recurrent; *Green*: Occasional; *Blue*: unfavorable

Table A.1: Monthly percentage of each productivity zone for the three variables (NPP, zooplankton and micronekton) inside the different areas: fully protected, highly protected and unprotected areas within the EEZ. This table includes both climatological and contemporaneous studies.

Type of zone	Month	Productivity zones	Climatological (%)			Contemporaneous (%)		
			NPP	Zooplankton	Micronekton	NPP	Zooplankton	Micronekton
Unprotected EEZ	1	Recurrent	25.79	17.14	13.37	30.34	26.06	21.38
		Occasional	55.1	44.84	36.45	38.77	28.28	23.98
		Unfavorable	19.12	38.02	50.18	30.88	45.66	54.64
	2	Recurrent	26.93	13.73	14.17	24.5	25.06	21.71
		Occasional	55.18	50.03	36.57	41.31	29.3	24.47
		Unfavorable	17.89	36.24	49.26	34.18	45.64	53.82
	3	Recurrent	21.34	10.87	13.19	21.44	23.52	21.64
		Occasional	46.49	45.56	37.99	37.55	30.05	25.21
		Unfavorable	32.17	43.57	48.82	41.01	46.43	53.15
	4	Recurrent	8.02	11.79	12.6	15.64	21.76	21.75
		Occasional	45.78	48.63	39.34	28.96	27.52	24.94
		Unfavorable	46.2	39.58	48.05	55.4	50.72	53.31
	5	Recurrent	7.03	8.59	13.77	10.85	16.78	21.69
		Occasional	25.55	34.73	40.07	20.01	22.09	25.31
		Unfavorable	67.42	56.69	46.16	69.15	61.13	53

Unprotected EEZ							
6	Recurrent	10.19	3.77	15.6	11.92	11.66	21.83
	Occasional	17.81	25.6	40.92	15.32	17.34	25.8
	Unfavorable	72	70.63	43.48	72.76	70.99	52.37
7	Recurrent	12.19	9.06	15.16	12.72	11.49	22.11
	Occasional	20.12	20.58	40.55	17.85	15.55	25.79
	Unfavorable	67.69	70.36	44.29	69.43	72.96	52.1
8	Recurrent	19.61	10.64	17	15.21	12.99	21.66
	Occasional	14.43	18.67	37.3	17.3	15.17	25.1
	Unfavorable	65.95	70.7	45.7	67.49	71.84	53.24
9	Recurrent	17.77	11.01	15.25	17.4	14.58	21.31
	Occasional	19.15	21.95	35.81	20.02	16.63	24.07
	Unfavorable	63.08	67.04	48.95	62.58	68.8	54.62
10	Recurrent	8.86	13.65	14.11	18.61	17.24	21.61
	Occasional	37.81	26.49	35.35	26.62	19.16	23.81
	Unfavorable	53.33	59.86	50.55	54.77	63.6	54.58
11	Recurrent	16.84	13.83	11.15	26.45	20.21	22.08
	Occasional	42.67	30.73	36.57	26.45	20.7	23.15
	Unfavorable	40.49	55.44	52.28	47.1	59.09	54.77

Unprotected EEZ	12	Recurrent	43.4	14.98	12.49	35.24	23.86	21.7
		Occasional	38.74	40.33	36.91	33.5	24.01	23.85
		Unfavorable	17.86	44.69	50.6	31.26	52.13	54.45
Fully protected	1	Recurrent	0.04	25.24	17.66	3.8	26.3	28.33
		Occasional	3.77	47.16	75.93	10.96	29.72	39.14
		Unfavorable	96.2	27.61	6.4	85.24	43.98	32.52
	2	Recurrent	0.00	14.05	21.73	4.46	22.32	29.66
		Occasional	9.19	46.33	70.51	15.64	29.6	37.04
		Unfavorable	90.81	39.62	7.76	79.91	48.07	33.31
	3	Recurrent	0.00	6.97	16.91	9.1	23.45	29.26
		Occasional	33.11	63.62	65.65	29.04	34.2	34.57
		Unfavorable	66.89	29.42	17.44	61.86	42.35	36.17
	4	Recurrent	0.26	5.65	13.86	14.65	29.51	25.91
		Occasional	99.1	94.24	67.65	50.77	46	32.79
		Unfavorable	0.64	0.11	18.49	34.58	24.49	41.3
	5	Recurrent	0.75	2.6	12.05	23.53	34.71	24.22
		Occasional	97.89	96.76	62.34	62.12	55.71	32.27
		Unfavorable	1.36	0.64	25.61	14.35	9.58	43.5

Fully protected							
6	Recurrent	5.54	1.47	13.79	24.71	32.39	24.19
	Occasional	89.11	96.2	62.03	56.99	56.17	31.04
	Unfavorable	5.35	2.34	24.18	18.3	11.44	44.77
7	Recurrent	6.85	10.51	11.9	29.35	32.22	25.33
	Occasional	92.13	87.46	66.37	53.99	51.4	32.06
	Unfavorable	1.02	2.03	21.73	16.66	16.38	42.61
8	Recurrent	15.25	15.22	12.81	28.62	35.68	28.48
	Occasional	83.16	82.79	76.57	58.27	48.81	34.76
	Unfavorable	1.58	2	10.62	13.11	15.51	36.77
9	Recurrent	5.61	6.18	12.35	31.78	36.55	29.5
	Occasional	93.11	91.6	83.77	62.58	50.05	38.03
	Unfavorable	1.28	2.22	3.88	5.64	13.4	32.47
10	Recurrent	13.48	10.96	14.95	34.62	39.49	32.78
	Occasional	86.06	87.76	82.18	60.9	49.44	38.05
	Unfavorable	0.45	1.28	2.86	4.49	11.07	29.16
11	Recurrent	4.41	6.14	13.82	29.75	39.08	30.68
	Occasional	95.59	92.99	80.49	54.41	48.45	38.42
	Unfavorable	0.00	0.87	5.69	15.84	12.47	30.91
12	Recurrent	1.09	19.28	20	10.93	36.78	30.09
	Occasional	22.94	80.72	77.06	20.31	42.55	39.67
	Unfavorable	75.97	0.00	2.94	68.76	20.68	30.23

Highly protected							
1	Recurrent	45.07	16.36	10.04	38.48	20.52	16.03
	Occasional	39.73	30.76	16.82	35.69	22.08	17.16
	Unfavorable	15.2	52.88	73.14	25.83	57.4	66.81
2	Recurrent	39.59	10.08	8.32	28.69	19.61	15.66
	Occasional	39.73	33.97	18.36	34.92	23.03	18
	Unfavorable	20.68	55.95	73.33	36.39	57.36	66.33
3	Recurrent	24.58	10.69	7.39	21.95	17.28	14.9
	Occasional	26.07	26.39	21.93	31.53	21.41	17.09
	Unfavorable	49.35	62.92	70.68	46.52	61.3	68.01
4	Recurrent	5.86	16.4	12.96	15.35	16.43	16.27
	Occasional	43.68	24.3	19.47	26.24	20.24	16.98
	Unfavorable	50.46	59.29	67.57	58.41	63.33	66.75
5	Recurrent	6.83	17.84	15.89	9.54	13.04	16.22
	Occasional	27.32	14.13	19.98	19.55	16.18	18.27
	Unfavorable	65.85	68.03	64.13	70.91	70.78	65.51
6	Recurrent	7.43	4	14.87	10.79	8.11	16.84
	Occasional	19.66	13.66	19.84	12.51	11.76	18.25
	Unfavorable	72.91	82.34	65.29	76.69	80.13	64.91
7	Recurrent	6.6	1.49	12.73	7.7	6.31	15.95
	Occasional	14.5	5.9	24.35	13.67	9.29	18.93
	Unfavorable	78.9	92.61	62.92	78.63	84.4	65.12

Highly protected	8	Recurrent	8.69	2.23	12.64	8.44	5.88	15.92
		Occasional	2.23	3.3	16.59	6.95	6.31	17.63
		Unfavorable	89.08	94.47	70.77	84.61	87.81	66.45
	9	Recurrent	7.95	2.51	11.11	10.18	6.4	15.37
		Occasional	7.76	3.25	15.52	9.62	7.11	16.2
		Unfavorable	84.29	94.24	73.37	80.19	86.49	68.42
	10	Recurrent	5.02	7.06	4.88	14.8	10.14	15.01
		Occasional	28.81	5.34	17.43	17.88	9.59	15.85
		Unfavorable	66.17	87.59	77.7	67.32	80.26	69.15
	11	Recurrent	22.17	8.22	8.88	24.56	12.08	15.48
		Occasional	30.62	8.69	16.22	18.59	12.31	15.92
		Unfavorable	47.21	83.09	74.91	56.85	75.61	68.61
	12	Recurrent	71.33	16.12	7.9	39.32	17.21	15.53
		Occasional	16.64	12.64	16.03	28.94	16.76	16.26
		Unfavorable	12.04	71.24	76.07	31.74	66.03	68.21

Table A.2: Monthly percentage of each productivity zone for the three variables (NPP, zooplankton and micronekton) inside the different areas: fully protected, highly protected and unprotected areas within the 100NM. This table includes both climatological and contemporaneous studies.

Type of zone	Month	Productivity zones	Climatological (%)			Contemporaneous (%)		
			NPP	Zooplankton	Micronekton	NPP	Zooplankton	Micronekton
Unprotected 100NM	1	Recurrent	8.74	22.99	23.23	23.45	31.73	25.79
		Occasional	68.61	60.6	46.61	46.9	33.95	28.28
		Unfavorable	22.65	16.41	30.16	29.65	34.32	45.93
	2	Recurrent	6.87	14.23	22.85	20.44	29.31	25.94
		Occasional	71.00	67.14	49.43	48.81	35.68	28.87
		Unfavorable	22.13	18.63	27.72	30.75	35.01	45.19
	3	Recurrent	13.87	12.97	17.8	21.16	27.31	25.54
		Occasional	70.76	67.87	53.36	47.09	37.42	29.43
		Unfavorable	15.37	19.17	28.84	31.75	35.27	45.03
	4	Recurrent	6.27	11.57	18.49	17.86	27.21	25.05
		Occasional	62.12	67.17	52.25	39.62	36.17	29.06
		Unfavorable	31.61	21.26	29.26	42.52	36.61	45.89
	5	Recurrent	12.22	11.72	17.88	14.66	21.82	24.29
		Occasional	35.63	47.16	54.76	24.19	28.3	29.57
		Unfavorable	52.15	41.12	27.35	61.15	49.88	46.14

Unprotected 100NM							
6	Recurrent	18.99	6.01	17.28	18.48	15.86	23.9
	Occasional	22.47	32.36	55.04	17.8	21.26	29.35
	Unfavorable	58.54	61.63	27.68	63.73	62.88	46.75
7	Recurrent	25.16	15.43	16.74	20.69	16.19	25.05
	Occasional	24.31	22.66	56.86	22.07	18.59	29.71
	Unfavorable	50.54	61.91	26.4	57.24	65.22	45.23
8	Recurrent	39.06	20.14	17.38	23.03	18.78	24.51
	Occasional	11.82	20.2	54.59	23.44	18.3	29.16
	Unfavorable	49.12	59.66	28.03	53.52	62.93	46.34
9	Recurrent	32.88	18.11	20.41	26.42	20.39	25.15
	Occasional	19.94	26.64	52.27	26.41	20.99	28.82
	Unfavorable	47.18	55.25	27.32	47.16	58.62	46.03
10	Recurrent	9.35	20.52	17.95	26.95	23.27	25.56
	Occasional	58.17	32.88	52.2	36.4	24.62	29.11
	Unfavorable	32.48	46.61	29.85	36.65	52.11	45.33
11	Recurrent	19.98	18.75	18.89	34.45	27.04	26.29
	Occasional	61.36	42.04	49.34	37.38	26.5	27.79
	Unfavorable	18.66	39.21	31.77	28.17	46.45	45.91

Unprotected 100NM	12	Recurrent	30.02	25.31	22.07	34.9	31.26	26.23
		Occasional	64.99	53.39	47.99	43.71	30.7	28.42
		Unfavorable	4.99	21.3	29.93	21.39	38.04	45.35
Fully protected	1	Recurrent	0.13	24.3	33.86	6.98	26.29	26.64
		Occasional	9.43	47.81	49.8	19.99	29.11	33.45
		Unfavorable	90.44	27.89	16.33	72.92	44.6	39.91
	2	Recurrent	0.00	15.8	27.09	6.46	23.3	26.1
		Occasional	16.73	47.01	53.25	23.36	30.32	31.79
		Unfavorable	83.27	37.18	19.65	70.19	46.38	42.11
	3	Recurrent	0.00	8.23	16.87	12.91	23.63	27.22
		Occasional	64.28	68.66	50.2	37.98	35.14	30.64
		Unfavorable	35.72	23.11	32.93	49.10	41.24	42.13
	4	Recurrent	0.53	3.59	12.08	17.56	28.69	21.75
		Occasional	97.88	96.02	51.26	60.29	48.19	30.58
		Unfavorable	1.59	0.4	36.65	22.15	23.12	47.67
	5	Recurrent	2.66	6.24	14.34	27.03	33.34	22.38
		Occasional	92.96	91.5	53.92	51.47	52.02	31.24
		Unfavorable	4.38	2.26	31.74	21.49	14.64	46.38

Fully protected							
6	Recurrent	11.02	4.38	17.13	93.89	30.72	21.85
	Occasional	81.54	87.38	40.5	45.88	46.6	27.72
	Unfavorable	7.44	8.23	42.36	25.84	22.67	50.43
7	Recurrent	22.44	24.3	11.29	32.38	30.62	23.69
	Occasional	74.5	68.53	50.46	44.16	40.78	28.42
	Unfavorable	3.05	7.17	38.25	23.44	28.6	47.89
8	Recurrent	52.46	35.33	11.42	33.97	34.13	25.74
	Occasional	42.1	57.64	77.03	44.75	37.46	33.58
	Unfavorable	5.44	7.04	11.55	21.30	28.41	40.67
9	Recurrent	15.94	18.06	23.11	36.36	33.9	26.61
	Occasional	79.55	74.1	65.87	50.68	41.05	35.2
	Unfavorable	4.52	7.84	11.02	12.99	25.06	38.19
10	Recurrent	5.05	17.26	16.07	35.10	37.19	29.31
	Occasional	93.36	78.22	76.49	56.92	41.29	35.56
	Unfavorable	1.59	4.52	7.44	7.93	21.52	35.13
11	Recurrent	11.95	11.42	22.84	36.37	37.21	27.61
	Occasional	88.05	85.52	62.28	51.76	40.96	35.03
	Unfavorable		3.05	14.87	11.88	21.83	37.36

Fully protected	12	Recurrent	3.72	40.11	38.51	19.96	35.11	28.47
		Occasional	62.68	59.89	53.39	32.61	37.65	32.93
		Unfavorable	33.6	0.00	8.1	47.46	27.24	38.6
Highly protected	1	Recurrent	0.00	35.75	31.31	8.74	35.15	26.77
		Occasional	93.69	63.32	26.87	68.61	33.8	24.17
		Unfavorable	6.31	0.93	41.82	22.65	31.05	49.06
	2	Recurrent	0.23	20.79	21.73	6.87	33.54	25.21
		Occasional	93.22	77.8	44.63	71.00	35.99	25.87
		Unfavorable	6.54	1.4	33.64	22.13	30.47	48.92
	3	Recurrent	30.37	22.43	22.2	13.87	29.17	23.07
		Occasional	69.63	72.9	52.57	70.76	34.06	27.24
		Unfavorable	0.00	4.67	25.23	15.37	36.77	49.69
	4	Recurrent	0.00	7.24	32.71	6.27	25.81	25.79
		Occasional	50.00	53.74	45.09	62.12	30.54	25.14
		Unfavorable	50.00	39.02	22.2	31.61	43.66	49.07
	5	Recurrent	10.51	6.07	43.22	12.22	14.2	25.83
		Occasional	31.07	36.92	39.25	35.63	19.46	26.29
		Unfavorable	58.41	57.01	17.52	52.15	66.34	47.89

Highly protected	6	Recurrent	16.36	0.7	38.32	18.99	9.61	22.94
		Occasional	7.24	10.75	44.63	22.47	12.31	27.29
		Unfavorable	76.4	88.55	17.06	58.54	78.08	49.77
	7	Recurrent	32.94	2.57	37.15	25.16	9.68	26.96
		Occasional	6.31	5.37	49.53	24.31	11.04	25.67
		Unfavorable	60.75	92.06	13.32	50.54	79.29	47.37
	8	Recurrent	35.51	10.05	25.23	39.06	10.97	23.45
		Occasional	0.93	3.74	46.03	11.82	10.84	26.63
		Unfavorable	63.55	86.21	28.74	49.12	78.19	49.92
	9	Recurrent	36.21	11.21	20.09	32.88	13.71	22.67
		Occasional	3.74	3.27	37.85	19.94	11.96	24.66
		Unfavorable	60.05	85.51	42.06	47.18	74.33	52.67
	10	Recurrent	4.21	18.69	7.94	9.35	16.3	22.58
		Occasional	46.73	13.08	49.77	58.17	17.13	26.15
		Unfavorable	49.07	68.22	42.29	32.48	66.57	51.27
	11	Recurrent	30.37	19.63	26.64	19.98	20.15	25.74
		Occasional	44.86	23.6	38.32	61.36	19.07	24.16
		Unfavorable	24.77	56.78	35.05	18.66	60.78	50.1
	12	Recurrent	40.19	37.15	19.86	30.02	29.73	24.55
		Occasional	59.81	31.78	35.05	64.99	26.11	23.62
		Unfavorable	0.00	31.07	45.09	4.99	44.16	51.83

Table A.3: Monthly percentage of each productivity zone for the three variables (NPP, zooplankton and micronekton) and three functional groups, the survey effort and the 100NM zone. This table includes both climatological and contemporaneous studies.

Functional group	Month	Total sightings	Productivity zones	Climatological (%)			Contemporaneous (%)		
				NPP	Zooplankton	Micronekton	NPP	Zooplankton	Micronekton
Baleen whale	5	138	Recurrent	15.33	6.57	14.81	9.49	21.17	20.74
			Occasional	6.57	50.36	55.56	5.84	29.93	35.56
			Unfavourable	78.10	43.07	29.63	84.67	48.91	43.70
	6	132	Recurrent	37.40	3.82	16.28	25.19	17.56	18.60
			Occasional	3.82	31.30	67.44	25.95	25.95	45.74
			Unfavourable	58.78	64.89	16.28	48.85	56.49	35.66
	7	113	Recurrent	50.45	19.82	3.60	41.44	16.22	23.42
			Occasional	38.74	33.33	81.98	37.84	29.73	38.74
			Unfavourable	10.81	46.85	14.41	20.72	54.05	37.84
	8	34	Recurrent	/	/	/	/	/	/
			Occasional	/	/	/	/	/	/
			Unfavourable	/	/	/	/	/	/
	9	5	Recurrent	/	/	/	/	/	/
			Occasional	/	/	/	/	/	/
			Unfavourable	/	/	/	/	/	/

5	2114	Recurrent	14.00	6.32	12.80	11.95	13.61	18.00
6	2678	Occasional	9.90	45.03	58.12	15.22	36.00	36.11
		Unfavourable	76.10	48.65	29.09	72.83	50.39	45.89
		Recurrent	48.67	2.74	11.57	19.50	13.54	20.01
7	2986	Occasional	1.97	29.21	66.19	19.11	23.75	40.06
		Unfavourable	49.36	68.05	22.24	61.39	62.71	39.94
		Recurrent	50.92	12.93	10.22	28.35	15.50	22.54
8	2076	Occasional	22.60	18.17	64.19	31.18	19.60	28.69
		Unfavourable	26.48	68.90	25.59	40.47	64.90	48.76
		Recurrent	33.94	8.02	6.26	19.69	15.12	15.27
9	775	Occasional	49.22	27.26	49.40	56.59	19.69	29.55
		Unfavourable	16.83	64.72	44.34	23.72	65.20	55.17
		Recurrent	18.67	8.57	1.51	17.28	14.97	16.14
5	274	Occasional	73.15	29.60	37.85	70.21	20.52	27.60
		Unfavourable	8.18	61.84	60.65	12.5	64.51	56.26
		Recurrent	9.63	8.15	14.03	11.85	12.22	17.42
Deep divers	274	Occasional	7.78	39.63	55.30	9.26	33.70	27.65
		Unfavourable	82.59	52.22	30.68	78.89	54.07	54.92

Deep divers	6	552	Recurrent	40.96	3.14	14.02	22.69	14.76	22.73
			Occasional	2.3	25.46	64.58	17.53	20.30	38.45
			Unfavourable	57.01	71.40	21.40	59.78	64.94	38.83
	7	813	Recurrent	51.19	15.14	13.49	26.66	17.15	27.24
			Occasional	19.40	18.27	67.47	26.91	16.65	26.23
			Unfavourable	29.41	66.58	19.04	46.43	66.21	46.53
	8	418	Recurrent	46.06	11.08	8.16	22.17	17.49	19.64
			Occasional	32.02	32.03	63.01	44.34	19.46	32.91
			Unfavourable	21.92	56.90	28.83	33.50	63.05	47.45
Survey Effort	9	119	Recurrent	23.89	8.85	4.04	15.93	17.70	19.19
			Occasional	62.83	32.74	42.42	67.26	20.35	23.23
			Unfavourable	13.27	58.41	53.54	16.81	61.95	57.58
	5	5853	Recurrent	20.94	6.39	13.89	11.16	16.43	19.99
			Occasional	19.09	49.54	57.44	9.71	31.36	32.91
			Unfavourable	59.97	44.07	28.67	79.13	52.21	47.1
	6	8313	Recurrent	43.91	3.15	10.66	18.06	13.41	20.84
			Occasional	2.44	25.74	62.00	18.57	21.63	35.54
			Unfavourable	53.65	71.12	27.34	63.37	64.96	43.62

Survey Effort	7	9155	Recurrent	52.12	11.38	8.53	27.67	15.68	22.54
			Occasional	22.5	19.52	63.26	28.82	20.56	29.86
			Unfavourable	25.37	69.1	28.21	43.51	63.76	47.59
	8	6557	Recurrent	44.57	11.79	8.75	21.09	14.16	15.06
			Occasional	36.09	26.44	59.45	50.02	19.91	27.57
			Unfavourable	19.34	61.77	31.8	28.88	65.93	57.37
	9	2958	Recurrent	35.54	12.7	8.42	22.88	17.98	13.95
			Occasional	46.24	31.12	54.39	61.02	21.62	24.95
			Unfavourable	18.22	56.18	37.19	16.1	60.41	61.1
100NM	5	/	Recurrent	7.96	10.96	21.03	24.71	22.45	24.71
			Occasional	35.27	48.3	52.56	29.33	28.68	29.33
			Unfavourable	56.77	40.74	26.41	45.95	48.87	45.95
	6	/	Recurrent	13.35	6.08	21.9	23.3	16.2	23.3
			Occasional	22.92	30.78	51.36	29.16	21.02	29.16
			Unfavourable	63.73	63.14	26.74	47.54	62.78	47.54
	7	/	Recurrent	15.17	13.05	20.31	25.32	16.14	25.32
			Occasional	30.35	22.84	54.61	29.65	18.41	29.65
			Unfavourable	54.48	64.11	25.08	45.03	65.45	45.03
	8	/	Recurrent	30.45	18.4	20.34	24.94	19.58	24.94
			Occasional	18.73	21.66	51.93	29.24	18.26	29.24
			Unfavourable	50.81	59.94	27.72	45.82	62.16	45.82

100NM	9	/	Recurrent	25.66	16.41	20.94	25.12	20.47	25.12
			Occasional	28.5	27.75	51.46	29.12	21.31	29.12
			Unfavourable	45.84	55.83	27.6	45.76	58.22	45.76