GSA Data Repository 2017167

B.P. Horton et al., 2017, Response times of microfossils to rapid sea-level rise: Timing of response of two microfossil groups to a sudden tidal-flooding experiment in Cascadia: Geology, doi:10.1130/G38832.1.

APPENDIX DR1 –METHODS USED IN THE STUDY

For foraminiferal and diatom analyses, two sets of surface samples of 1 cm thickness each were taken from alternating corners of a 1x1 m sampling quadrant at three stations (stations 1-3) in the Ni-les'tun salt marsh (Fig. 1 d, Table DR1) prior to tide gate removal on 15-16 August 2011. After tidal restoration, samples were taken monthly in the first 12 months, and subsequently every two and then every six months until March 2016. The samples for foraminiferal analysis were stained with Rose Bengal on the day of sampling for identification of living specimens (Walton, 1952), stored in a buffered ethanol/ water solution (50:50) in order to avoid dissolution of calcareous tests and refrigerated at 5°C. Wet sample volume from each sample was measured and samples were wet-sieved through 500 µm and 63 µm screens. The fraction >500 µm was examined for larger foraminifera before being discarded. A wet-splitter (Scott and Hermelin, 1993) was used to split the fraction between 63-500 µm into eight equal aliquots as described in Horton and Edwards (2006). Live and dead foraminiferal tests were counted wet under a binocular microscope to facilitate the detection of stained foraminifera and to prevent drying of the organic residue (de Rijk, 1995; Table DR2). Only tests with all but the last chamber clearly stained red were counted as living at the time of collection. Taxa were identified according to the taxonomic descriptions in Horton and Edwards (2006), Hawkes et al. (2010), and Wright et al. (2011). Foraminifera were classified into two subenvironments: tidal flat/ low marsh taxa and middle/ high marsh taxa following previous studies in Oregon (Hawkes et al., 2010; Engelhart et al., 2013; Milker et al., 2015a; Table DR2).

A total of 60 diatom slides were prepared from Stations 1, 2, and 3 using the following method:

(1) ~1 g of sediment was subsampled and oxidized with hydrogen peroxide to remove organic material. Samples were gently heated in a water bath to accelerate the oxidation;
(2) Samples were rinsed three times in a centrifuge with distilled water;
(3) A known volume of digested sample (between 25 and 100 ml depending on the diatom concentration) was pipetted and distributed evenly on a cover slip;
(4) The cover slip was dried overnight and then inverted and mounted on a glass slide using Naphrax.

Diatoms were identified to species level using a Leica light microscope under oil immersion at 1000x magnification with reference to Krammer et al. (1986), Krammer and Lange-Bertalot (1988, 1991a,b) and Witkowski et al. (2000) and digital reference collections held by The University of Colorado (2010, 2012) and The Academy of Natural Sciences of Drexel University (2012) (Table DR3). When possible, 400 diatoms were identified and counted in slides with each species expressed as a percentage of total diatom valves counted. Fragments containing more than half a valve were included in the count. Using the known volume/weight of sample used in making the diatom slides, the area of slide counted, and the number of valves observed in that area, the concentration of diatom valves per gram was calculated for each sample (Table DR3).

Only species that exceeded 4% of total valves counted were used for paleoecological interpretation. *Paralia sulcata*, a tychoplanktonic diatom that may form prominent allochthonous assemblages, was excluded from ecological interpretations (Hemphill-Haley, 1995a).

Diatom species were classified into three marsh subenvironments (freshwater/high marsh, low marsh, and tidal flat/subtidal channel) following previous studies in Oregon and Washington (Atwater and Hemphill-Haley 1997; Hemphill-Haley, 1993, 1995a, b, 1996; Sherrod, 1999; Sherrod et al. 2000; Sherrod, 2001; Witter et al., 2009; Sawai et al., 2016), and when necessary global catalogs (Denys, 1991; Hartley et al., 1996; Krammer et al., 1986, Krammer and Lange-Bertalot 1988, 1991a,b; Vos and de Wolf, 1988, 1993; Witkowski et al., 2000; Table DR4). The freshwater/high marsh group includes fresh and fresh-brackish diatoms that generally occur in salt concentrations less than 0.2 ‰. The low marsh diatom group includes brackish and brackish-marine species that tolerate salt concentrations between 0.2 and 30 psu. The intertidal flat/subtidal channel diatom group includes marine-brackish and marine species that thrive in salinities exceeding 30 ‰.

Diatoms were also classified by life-form (planktonic, epipelic, epiphytic, aerophilic). Diatom taxa that live attached to plants are defined as epiphytic forms; taxa that live on wet sediments are defined as epipelic forms; taxa that live on wet sediments but are able to survive temporarily dry conditions are defined as aerophilic forms (Table DR5). Tychoplanktonic diatoms include an array of species that live in the benthos, but are commonly found in the plankton. Diatoms that float in the water column and do not live attached to any substrate are defined as planktonic forms (Vos and de Wolf, 1988, 1993).

Samples for grain-size measurements were taken prior to restoration and monthly for the first 12 months (Fig. 2e). The surface samples were treated with hydrogen peroxide (20%) prior to analysis to oxidize organic matter. Grain-size distribution was determined with a Laser Diffraction Particle Size Analyzer. Particle size data are reported as differential volume (i.e., the percentage of total volume that each size class occupies) based on the Wentworth Phi Scale (Wentworth, 1922).

Station elevations were determined relative to the average elevation of an adjacent vegetation transect that were measured with Real-time Kinematic (RTK) GPS/GNSS and total station equipment (Brophy and van de Wetering, 2012). Elevations (Error = ± 2 cm) were referenced to the North American vertical datum (NAVD88) and mean tide level (MTL) (Table DR1). Measurements were taken at the beginning of the study (i.e., pre-restoration).

Pre- and post-restoration maximum tidal heights (Fig. 1a) were processed from water level data recorded at 15 minute intervals by tide gauges installed in lower Fahys Creek (Lower Fahys TG2), in the Coquille River (Coquille River TG2), and outside the restoration site in 2011 and 2012 (Fig. DR2). All water levels were referenced to NAVD88 and MTL. Pre- and post-restoration salinity data were recorded at 30 minute intervals by salinity loggers installed in Fahys Creek, in the Coquille River (i, ii, and ii on Fig. 1c), and outside the restoration site in 2011 and 2013 (Table DR1; Figs. 2b, DR1).

Post-restoration sedimentation rates were calculated from one 19-cm-long core (10 cm in diameter) recovered in March 2016 at Station 1. Sedimentation was 1.5 cm g/cm^2 from August 2011 until March 2016 (56 months) (Table DR1).

APPENDIX DR2 – LIVE AND DEAD FORAMINIFERAL DISTRIBUTION AT THE CONTROL SITE

In order to study the live and dead foraminiferal distribution at the control site (Bandon salt marsh), surface samples (0-1 cm depth) were taken July and October 2011 and in August and October 2012 (Milker et al., 2015b). Sample storage, preparation and foraminiferal investigations followed the methods described in Appendix DR1.

During the sampling period, on average between 384 and 599 live individuals (per 10 cm^3 sediment volume) at the tidal flat stations (St. 1-2), between 50 and741 individuals at the low marsh stations (St. 3-4), between 144 and 424 individuals at the high marsh stations (St. 5-9), and 30 individuals at the station in the highest marsh to upland transition (St. 10) were observed (Fig. DR2A). The live populations, averaged over the sampling period, were dominated by *Miliammina fusca* (76-99%) and *Haynesina* sp. (0-21%) in the tidal flat and low marsh (St. 1-4). The high marsh (St. 5-9) was dominated by *Jadammina macrescens* (6-43%), *Trochammina inflata* (0-34%), *M. fusca* (9-25%) and *Haplophragmoides* spp. (1-21%) and the highest marsh to upland transition (St. 10) by *Trochamminita irregularis* (55%) and *Balticammina pseudomacrescens* (34%).

In the dead assemblages had higher total numbers compared to the live populations. At the tidal flat stations (St. 1-2) between 1144 and 1166 individuals (per 10 cm^3), at the low marsh stations (St. 3-4) between 635 and 1474 individuals, at the high marsh stations (St. 5-9) between 388 and 1879 individuals and in the highest marsh to upland transition (St. 10) 251 individuals, averaged over the sampling period, were observed (Fig. DR2B). The dead assemblages were generally dominated by the same species such as in the live populations. The tidal flat and low marsh (St. 1-4), averaged over the sampling period, was dominated by *M. fusca* (91-99%) while *Haynesina* sp. has a lower relative abundance with 0-2%. *Jadammina macrescens* (21-64%), *T. inflata* (1-28%), *M. fusca* (6-26%) and *Haplophragmoides* spp. (1-18%) dominated in the high marsh (St.5-9), and *T. irregularis* (62%) and *B. pseudomacrescens* (27%) the highest marsh to upland transition (St. 10).

The live and dead foraminiferal distribution in the naturally developed Bandon marsh is comparable to other estuarine salt marshes where a vertical benthic foraminiferal distribution with respect to elevation is observed (e.g., Kemp et al., 2009; Hawkes et al., 2010; Engelhart et al., 2013). A comparison of the foraminiferal distributions at the control and restoration sites suggest that tidal restoration resulted in a long-term change from a high marsh to a tidal flat-low marsh environment, dominated by *M. fusca*, at St. 1 and the development of a middle-high marsh environment, dominated by *Haplophragmoides manilaensis, T. inflata* and *T. irregularis*, at St. 3 in the Ni-les'tun salt marsh. At St. 2, the assemblages suggest a tidal flat-low marsh environment during the first three years after tidal restoration, but then a change to a middle-high marsh assemblage occurred until September 2016 (own observations).

APPENDIX DR3 – LIVE FORAMINIFERAL DISTRIBUTION AT THE RESTORATION SITE

The live foraminiferal distribution is similar to the dead assemblages observed at the restoration site (Figs. 3a; DR3; Table DR2). At Station 1, there was a standing crop of 34 live specimens (per 10 cm^3 sediment volume) prior to restoration. The assemblage was characterized by middle and high-marsh species (e.g., *J. macrescens*, *B. pseudomacrescens* and *T. irregularis*). Standing crops increased although remained low at 66 ± 52 for 10 months after restoration. In June 2012, then months after restoration, standing crops increased to 800 per 10 cm^3. From June 2012 to March 2016, the post-restoration live assemblage was dominated (74-100%) by the low-marsh species *M. fusca*. At Station 2, the first notable numbers of living foraminifera appeared 16 months (December 2012) after restoration with a standing crop of 248 per 10 cm^3. *Miliammina fusca* was the dominant species with a relative abundance of 67–100% between 2012 and 2014. By March 2015 the abundance of *M. fusca* decreased and middle to high-marsh species such as *H. manilaensis* and *H. wilberti* firstly appeared. At Station 3, notable numbers of living foraminifera (standing crop of 272 per 10 cm^3) first appeared in September 2013, 25 months after restoration. Diverse, middle to high-marsh species such as *H. manilaensis* and *T. irregularis* dominated the assemblage since then.

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DATA REPOSITORY TABLES

Table DR1. Location and elevation of the stations, and location and sensor elevation of the tide gauges and salinity loggers installed at the restorations and control sites (Fig. 1c).

Table DR2: Raw live and dead foraminiferal counts, sample split and sample volume (in cm^3) (spreadsheet). Tidal flat-low marsh species are given in blue and middle-high marsh species are given in green.

Table DR3. Raw diatom counts and diatom concentrations (spreadsheet).

Table DR4. Diatom results summary (spreadsheet).

Table DR5. List of diatom taxa and ecological classifications (spreadsheet).

DATA REPOSITORY FIGURES

Figure DR1. Pre- (2011) and post-restoration (2013) salinity in the Coquille River and in Fahys Creek (a, b; i, ii, and ii on Fig. 1c) and post-restoration (2013) water level in the Coquille River and lower Fahys Creek (c; Fig. 1c, Table DR1).

Figure DR2. Total live (A) and dead (B) foraminiferal numbers (per 10 cm^3 sediment volume; given is the mean, maximum and minimum total number for the four sampling campaigns) and relative abundance of the most abundant living foraminifera, averaged over the four sampling campaigns, at the control site.

Figure DR3. Total live foraminiferal numbers (per 10 cm^3 sediment volume) at stations 1-3 during the pre- and post-restoration phases in the Ni-les'tun salt marsh. Note different scaling of the y-axes.

Table DR1. Location and elevation of the stations, and location and sensor elevation of the tide gauges and salinity loggers installed at the restorations and control sites (Fig. 1c).

Tide gauges (TG)	**Latitude**	**Longitude**	**Sensor elevation**	**Label in Fig. 1**
Coquille River TG2	43° 8.765'N	124° 23.561'W	-1.51	I
Lower Fahys Creek TG2	43° 8.898'N	124° 23.366'W	0.30	II
Salinity/temperature logger (no.)				
Coquille River (8234)	43° 8.768'N	124° 23.565'W	0.80	i
Fahys Creek mouth (8239)	43° 8.898'N	124° 23.366'W	0.37	ii
Fahys Creek mid (8230)	43° 9.257'N	124° 23.111'W	0.47	iii

Ni-les'tun (NM) stations			**Elevation (m NAVD88)**	**Elevation (m MTL)**	**Sediment-ation rate (cm)**
Station 1	43° 8.984'N	124° 23.270'W	1.45	0.33	1.5
Station 2	43° 9.120'N	124° 22.997'W	1.84	0.72	0.5
Station 3	43° 9.064'N	124° 23.263'W	2.07	0.95	0.0

Table DR2: Raw live and dead foraminiferal counts, sample split and sample volume (in cm3) (spreadsheet). Tidal flat-low marsh species are given in blue and middle-high marsh species are given in green.

		Live foraminifera														Dead foraminifera																
Sample ID	Date (month/day/year)	*Miliammina fusca*	*Haynesina* sp.	*Reophax* spp.	*Trochammina inflata*	*Haplophragmoides manilaensis*	*Haplophragmoides wilberti*	*Haplophagmoides* spp.	*Balticammina pseudomacrescens*	*Trochamminita irregularis*	*Jadammina macrescens*	*Miliammina petila*	juvenile Trochamminids	indetermine	Sum	*Miliammina fusca*	*Haynesina* sp.	*Reophax* spp.	*Ammobaculites* spp.	*Trochammina inflata*	*Haplophragmoides manilaensis*	*Haplophragmoides wilberti*	*Haplophagmoides* spp.	*Balticammina pseudomacrescens*	*Trochamminita irregularis*	*Jadammina macrescens*	*Miliammina petila*	juvenile Trochamminids	indetermine	sum	Split	Wet sample volume [cm^3]
1	08/16/11	8			4	1			8	6	6			4	37	123				28	50	5	0	62	126	170		62	40	666	2/8	43.6
1	09/02/11	1							2	1	1				5	177				5	21	0	0	51	50	85		54	7	450	1/8	41.1
1	09/14/11	26							19	16	2		2	2	67	102				0	7	0	0	16	30	13		2	0	170	1/8	30.5
1	09/28/11	1							9	12	1		5	4	32	129				0	10	0	0	62	65	35		8	14	323	1/8	40.3
1	10/14/11	1							8	1	7		3	1	21	102				0	33	0	0	24	57	57		31	4	308	3/8	28.8
1	11/07/11	1							4	5	8			1	19	140					25			16	17	23		15	2	238	4/8	17.5
1	12/14/11	54				1			18	11	22		7	2	115	63					12			17	41	35		6	4	178	5/8	26.8
1	01/12/12	13							13	18	6		5	2	57	76					37			26	37	56		11	1	244	5/8	21.5
1	02/09/12	14				1			5	15	16		6	2	59	78					26	2		16	61	44		3	1	231	8/8	17.2
1	04/11/12	34				1			8	5	2		1		51	93				2	35	1		68	64	59		6	8	336	2/8	27.8
1	05/16/12	37				1			21	13	5		1	2	80	90				1	44			34	46	17		4	1	237	2/8	22.5
1	06/19/12	156									1		1		158	76				3					3					82	1/8	15.8
1	07/24/12	92													92	207									0					207	1/8	20.0
1	08/29/12	496									3				499	2800				1	1			5	7	25		41		2880	8/8	30.0
1	10/11/12	39													39	132					1			3	4	2		2		144	1/8	14.5
1	12/08/12	63								2					65	243								1	5			1		250	1/8	14.5
1	02/27/13	120							2	3			1		126	132								2	9	1		1		145	1/8	16.5
1	05/31/13	134								1					135	356									2			6		364	1/8	15.0
1	09/24/13	44	2												46	407					1			4	5				0	417	2/8	15.7
1	03/12/14	189													189	93									0					93	1/8	22.2
1	09/04/14	52	5							1					58	305	1			2		1		4	0	1				314	1/8	27.0
1	03/10/15	144	4												148	169	1							2	5	4				181	2/8	20.2
1	10/15/15	56	20												76	287	10		1					1	2	1				302	1/8	18.0
1	03/18/16	44		2											46	272		2	3	1	1	1			6	1				287	1/8	23.8
2	08/15/11														0										0					0	8/8	21.4
2	10/14/11														0										0					0	8/8	37.8
2	12/14/11														0										0					0	8/8	15.5
2	03/09/12														0										0					0	8/8	31.4
2	06/19/12														0										0					0	8/8	26.5
2	07/24/12	4								1				1	6	1									0					1	8/8	19.0
2	08/29/12														0	11									0					11	8/8	21.8
2	10/11/12	35													35	137					1				0			1		139	8/8	21.0
2	12/08/12	422			1					3				1	427	27				2				2	2	4		2		39	8/8	17.0
2	02/27/13	99								3					102	7									1					8	6/8	15.5
2	05/31/13	121								10					131	67									4					71	1/8	32.0
2	09/24/13	28			2					2					32	207								1	4	1			0	213	2/8	14.5

2	03/12/14	220					1			4					225	207						2			9			1		219	1/8	30.5
2	09/04/14														0	92									0					92	1/8	26.5
2	03/10/15	63				23	2	1							89	42					90	2			2	13		2	3	154	1/64	29.0
2	10/15/15	17													17	113				2	13	21	1	5	13	5	1	3		177	3/8	14.6
2	03/18/16	354			6	5	16		4	5	4			2	396	397				18	20	11	3	23	23	38		4	1	538	1/8	23.0
3	08/16/11														0										0	1				1	8/8	24.2
3	10/14/11														0										0					0	8/8	19.5
3	11/07/11														0	1									0					1	8/8	25.0
3	03/09/12														0										0			1		1	8/8	18.2
3	07/24/12														0										0					0	8/8	18.2
3	10/11/12														0						1			1	0					2	8/8	15.0
3	12/08/12									2					2										12					12	8/8	13.5
3	02/27/13				2	2			8	2					14	1				3				7	5			2		18	8/8	17.5
3	05/31/13	2													2					1					6					7	8/8	18.5
3	09/24/13	9			10	32			3	4	1		4		63	8				14	88	2		91	24	6		39	0	272	1/8	18.5
3	03/12/14	24			5	245	1		11	49	2		7		344	15				4	89	1		19	58	6		29		221	1/8	22.5
3	09/04/14	73			4	5	6	1	8	18		2	3		120	26				5	16	2		26	51		1	8		135	1/8	31.5
3	03/10/15	70			1	27	11			8	44		6		167	38				1	18	3			5	36		2		103	2/8	19.2
3	10/15/15	25			10	55	8		7	2	2		2		111	54				5	100	22		18	17	8	9	22	1	256	1/8	17.6
3	03/18/16	37			10	46	36		1	8	6		3	1	148	35				73	53	39	5	13	30	15		16		279	2/8	21.0

Table DR3. Raw diatom counts and diatom concentrations (spreadsheet).

2017167_Table DR3.xlsx

Table DR4. Diatom results summary (spreadsheet).

2017167_Table DR4.xlsx

Table DR5: List of diatom taxa and ecological classifications.

Diatom taxa	Taxonomic authority	Ecological information (life form and preferred environment)	Classification in this paper
Achnanthes brevipes	Agardh 1824	Epiphyte, tidal flat (1); Tidal flat (2); Tidal flat (3); Low marsh/tidal flat (5); Tidal flat (6); Low marsh/tidal flat (7)	Tidal flat
Actinoclyclus normanii	(Gregory) Hustedt, 1957	Planktonic, subtidal (1)	Planktonic
Actinocyclus ochotensis	A.P. Jousé, 1969	Planktonic, subtidal (1)	Tidal flat
Actinoptychus senarius	(Ehrenberg) Ehrenberg, 1843	Tychoplanktonic, subtidal (1); Tidal flat (2); Tidal flat (6)	Planktonic
Bacillaria paradoxa	J.F.Gmelin, 1791	Epiphyte, tidal channel or low marsh (1); Tidal flat (4); Low marsh (5); Tidal flat (6); Low marsh/tidal flat (7)	Tidal flat
Caloneis bacillum	(Grunow) Cleve, 1894	Epipelic, high marsh (1); High marsh and low marsh (2); High marsh and low marsh (3); High marsh (5); Low marsh (6); High marsh and low marsh (7)	High marsh
Caloneis westii	(W. Smith) Hendey, 1964	Epipelic, low marsh and tidal flats (1); Low marsh and tidal flats (2); Low marsh (3); Low marsh (4); Low marsh (6)	Low marsh
Cavinula lapidosa	(Krasske) Lange-Bertalot, 1996	High marsh (6)	High marsh
Cocconeis scutellum	Ehrenberg, 1838	Epiphyte, tidal flat (1); Tidal flat (2); Tidal flat (3); Tidal flat (4); Tidal flat and low marsh (5); Tidal flat (6); Tidal flat (7)	Tidal flat
Cosmioneis pusilla	(W.Smith) D.G.Mann & A.J.Stickle, 1990	Epipelic, high marsh (1); High marsh (2); High marsh (3); High marsh (4); High marsh and low marsh (5); High marsh (6); High marsh (7)	High marsh
Delphineis kippae	Sancetta	Epipsammic, epiphyte, tidal flat (8)	Tidal flat
Delphineis surirella	(Ehrenberg) G.W.Andrews, 1981	Epipsammic, epiphyte, tidal flat (1); Tidal flat (2); Tidal flat (4); Tidal flat (6)	Tidal flat
Denticula subtilis	Grunow, 1862	Epipelic, high marsh (1); High marsh (2); High marsh (3); High marsh (4); High marsh (6); High marsh (7)	High marsh

Diploneis ovalis	(Hilse) Cleve, 1891	High marsh (6)	High marsh
Diploneis pseudovalis	Hustedt, 1930	Epipelic, high marsh (1); high marsh and low marsh (2); High marsh (3); High marsh and low marsh (4); High marsh (6)	High marsh
Diploneis smithii var. rhombica	Cleve-Euler, 1915	Epipelic, tidal flat (1); Low marsh (6); Low marsh (7)	Low marsh
Eunotia pectinales	Ehrenberg 1837	Epiphyte, high marsh/upland (1); Upland (6)	Freshwater/High marsh
Fallacia forcipata	(Greville) Stickle & Mann, 1990	Tidal flat or channel (6); Low marsh and tidal flat (7);	Low marsh
Frustulia vulgaris	(Thwaites) De Toni, 1891	Epipelic, high marsh (1); High marsh and low marsh (2); High marsh and low marsh (3); High marsh (4); High marsh (6); High marsh (7)	High marsh
Gomphonema parvulum	(Kützing) Kützing, 1849	High marsh or freshwater (1); Freshwater (6)	Freshwater/High marsh
Gyrosigma acuminatum	(Kützing) Rabenhorst, 1853	Tidal flat (4); Low marsh (6)	Low marsh
Gyrosigma eximium	(Thwaites) Boyer, 1927	Epipelic, low marsh (1); Low marsh (2); Low marsh (3) Low marsh (4); Low marsh (5); Low marsh (6); Low marsh (7)	Low marsh
Hyalodiscus scoticus	(Kützing) Grunow, 1879	Epiphyte, tidal flat (1); Tidal flat or channel (2); Tidal flat (3); Low marsh or tidal flat (5); Tidal flat or channel (6)	Tidal flat
Luticola mutica	(Kützing) D.G.Mann, 1990	Epiphyte, high marsh (1); High marsh and low marsh (2); High marsh and low marsh (4); High marsh and low marsh (6); High marsh (7)	
Mastogloia exigua	F.W.Lewis	Epipelic, low marsh (1); Low marsh and tidal flats and channels (2); Low marsh (3); Low marsh (4); Low marsh (6); Low marsh (7)	Low marsh
Melosira moniliformis	(O.F.Müller) C.Agardh, 1824	Epipelic, epiphyte, tidal flat and low marsh (1); Tidal flat or channel (2); Tidal flat or channel (3); Tidal flat (4) Tidal flat (6); Tidal flat (7)	Tidal flat
Melosira nummuloides	C.Agardh, 1824	Epipelic, epiphyte, tidal flat and low marsh (1); Tidal flat or channel (2); Tidal flat or channel (3); Tidal flat (4); Low marsh (5); Tidal flat (6); Tidal flat (7)	Tidal flat

Navicula cincta	(Ehrenberg) Ralfs, 1861	Epipelic, high marsh and low marsh (1); High marsh and low marsh (2); High marsh and low marsh (3); High marsh and low marsh (4); High marsh (6); High marsh and low marsh (7)	High marsh
Navicula gregaria	Donkin, 1861	Epipelic, low marsh and high marsh (1); Low marsh (4); Low marsh (7)	Low marsh
Navicula peregrina	(Ehrenberg) Kützing, 1844	Low marsh (5); Low marsh (6); Low marsh (7)	Low marsh
Navicula salinarium	Grunow, 1880	Epipelic, low marsh (1); High marsh and low marsh (5); Low marsh (7)	Low marsh
Navicula tripunctata	(O.F.Müller) Bory de Saint-Vincent, 1822	Epipelic, high marsh (2)	High marsh
Nitzschia brevissima	Grunow, 1880	Epipelic, high marsh (1); High marsh (3); High marsh (4); High marsh (7)	High marsh
Nitzschia commutata	Grunow, 1880	Epipelic, high marsh (1); High marsh (2) High marsh and low marsh (3) High marsh and low marsh (4); High marsh (6)	High marsh
Nitzschia dubia	W.Smith, 1853	Low marsh (6)	Low marsh
Nitzschia scapelliformis	(Grunow) Grunow, 1880	Epipelic, low marsh (1); Low marsh (2); Low marsh (3); Low marsh (4) Low marsh (7)	Low marsh
Nitzschia sigma	(Kützing) W.Smith, 1853	Epipelic, tidal flat and low marsh (1); Tidal flat or channel (2); Tidal flat or channel (3); Tidal flat (4); Tidal flat (6); Low marsh (7)	Tidal flat
Odontella aurita	(Lyngbye) C.Agardh, 1832	Planktonic, tidal flat (1); Tidal flat (2); Tidal flat (4); Planktonic or tychoplanktonic (6)	Tidal flat
Opephora marina	(Gregory) Petit, 1888	Epipsammic, tidal flat (1); Tidal flat or channel (3); Low marsh and tidal flat (5); Tidal flat or channel (6)	Tidal flat
Petroneis marina	(Ralfs) D.G.Mann, 1990	Epipelic, tidal flat (1); Tidal flat (4)	Tidal flat
Pinnularia intermedia	(Lagerstedt) Cleve, 1895	Aerophilic, freshwater or high marsh (8)	Freshwater/High marsh
Pinnularia lagerstedtii	(Cleve) Cleve-Euler, 1934	Aerophilic, high marsh (2); High marsh (4); High marsh (3); Freshwater or high marsh (5); High marsh (6)	High marsh

Pinnularia microstauron	(Ehrenberg) Cleve, 1891	Aerophilic, freshwater or high marsh (5); Freshwater or high marsh (6)	Freshwater/High marsh
Pinnularia viridis	(Nitzsch) Ehrenberg, 1843	Aerophilic, freshwater or high marsh (6)	Freshwater/High marsh
Planothidium delicatulum	(Kützing) Round & Bukhtiyarova, 1996	Epipsammic, tidal flat (1); Tidal flat or channel (2); Tidal flat or channel (3); Tidal flat (4); Low marsh and tidal flat (5); Tidal flat or channel (6); Tidal flat or low marsh (7)	Tidal flat
Planothidium lanceolatum	(Brébisson ex Kützing) Lange-Bertalot 1999	Epipsammic, epiphyte, low marsh (1); Tidal flat (2); Low marsh (6); Low marsh (7)	Low marsh
Rhaphoneis psammicola	R.Z.Riznyk	Epipsammic, tidal flat (1); Tidal flat or channel (2); Tidal flat (4); Tidal flat or channel (6)	Tidal flat
Rhopalodia musculus	(Kützing) Otto Müller, 1900	Epiphyte, epipelic, low marsh (1); Low marsh (2); Low marsh (3); Low marsh (4); Low marsh (5)	Low marsh
Stauroneis anceps	Ehrenberg, 1843	Epipelic, high marsh (1); High marsh (2)	
Surirella brebissonii	Krammer & Lange-Bertalot, 1987	Epipelic, low marsh (1); Low marsh (5)	Low marsh
Surirella ovalis	Brébisson, 1838	Low marsh (7)	Low marsh
Tabularia fasciculata	(C.Agardh) D.M.Williams & Round, 1986	Epiphyte, tidal flat (1); Tidal flat or channel (2); Tidal flat or channel (3); Tidal flat (4); Tidal flat or channel (6); Tidal flat and low marsh (7)	Tidal flat
Thalassiosira antiqua	(Grunow) Cleve	Planktonic or tychoplanktonic, tidal flat (6)	Tidal flat
Thalassiosira pacifica	Gran & Angst, 1931	Planktonic or tychoplanktonic, tidal flat (6)	Tidal flat
Tryblionella debilis	Arnott ex O'Meara, 1873	Epipelic, low marsh (1); Low marsh and high marsh (2); Low marsh and high marsh (3); Low marsh (4); Low marsh (6); Low marsh (7)	Low marsh
Tryblionella granulata	(Grunow) D.G.Mann, 1990	Epipelic, tidal flat (1); Tidal flat or channel (2); Tidal flat or channel (3); Tidal flat (4); Tidal flat or channel (6)	Tidal flat
Tryblionella levidensis	W.Smith, 1856	Epipelic, tidal flat (1); Tidal flat or channel (3); Tidal flat (4); Tidal flat or channel (6); Tidal flat (7)	Tidal flat

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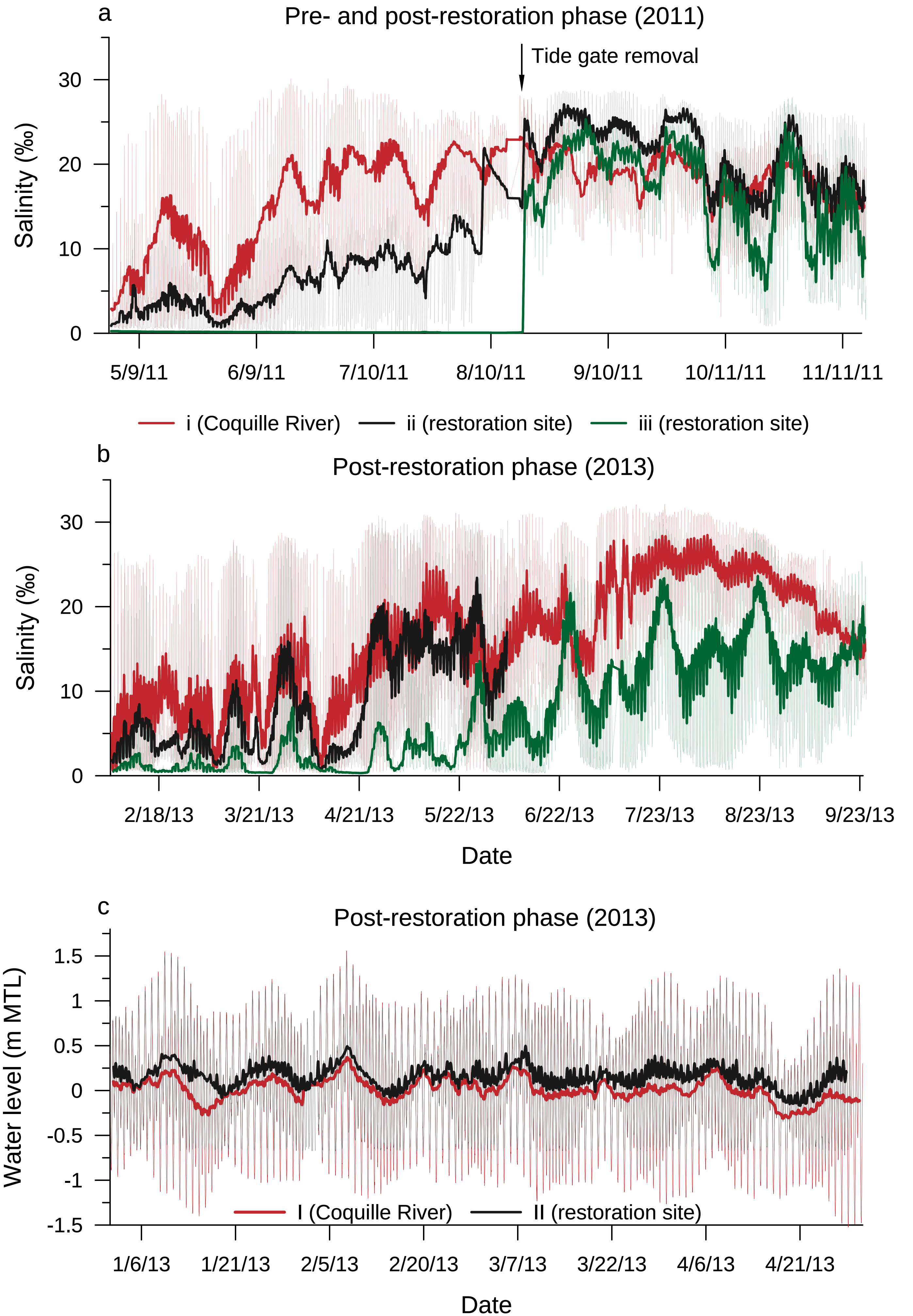


a
Pre- and post-restoration phase (2011)
Tide gate removal
Salinity (‰)
30
20
10
0
5/9/11
6/9/11
7/10/11
8/10/11
9/10/11
10/11/11
11/11/11
i (Coquille River)
ii (restoration site)
iii (restoration site)
b
Post-restoration phase (2013)
Salinity (‰)
30
20
10
0
2/18/13
3/21/13
4/21/13
5/22/13
6/22/13
7/23/13
8/23/13
9/23/13
Date
c
Post-restoration phase (2013)
Water level (m MTL)
1.5
1
0.5
0
-0.5
-1
-1.5
I (Coquille River)
II (restoration site)
1/6/13
1/21/13
2/5/13
2/20/13
3/7/13
3/22/13
4/6/13
4/21/13
Date

Figure DR1

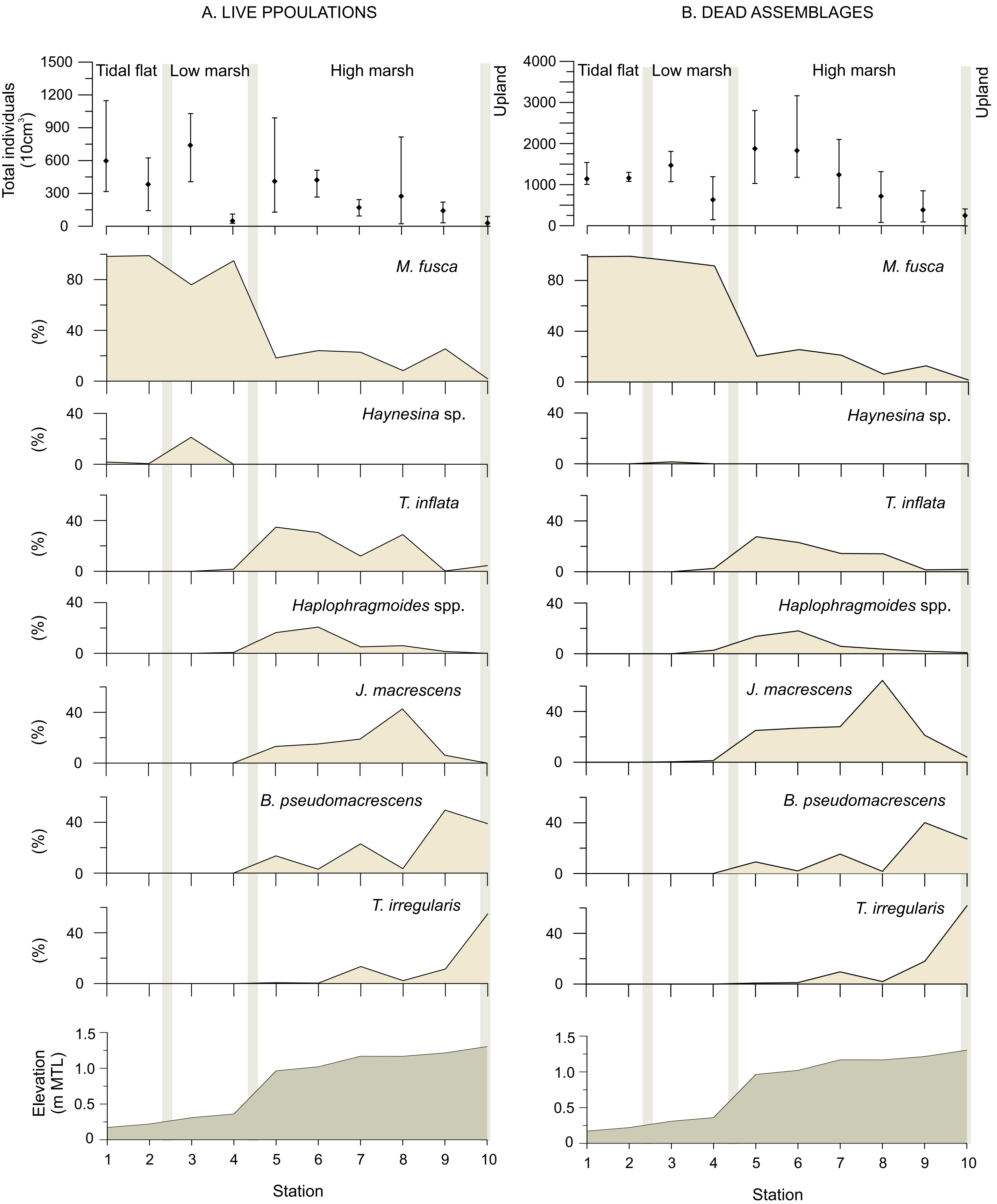
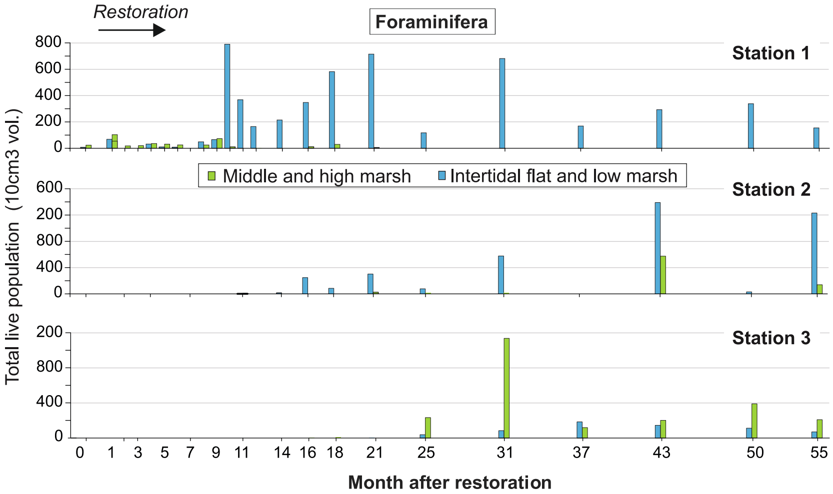

A. LIVE PPOULATIONS
B. DEAD ASSEMBLAGES
Total individuals (10cm^3)
Tidal flat
Low marsh
High marsh
Upland
M. fusca
Haynesina sp.
T. inflata
Haplophragmoides spp.
J. macrescens
B. pseudomacrescens
T. irregularis
(%)
Elevation (m MTL)
Station

Figure DR2



Restoration
Foraminifera
Station 1
Station 2
Station 3
Middle and high marsh
Intertidal flat and low marsh
Total live population (10cm3 vol.)
Month after restoration

Figure DR3