Text S1. Detailed description of study site and study species

The region has a warm temperate continental monsoon climate and tides are irregular and semidiurnal. The average annual temperature is 12.8 °C and the average annual precipitation is 537.3 mm (Hu & Cao 2003, He et al. 2015). Within the region, *Suaeda salsa* dominates most intertidal and uptidal salt marshes due to wide tolerance to salinity and flooding stresses. *Phragmites australis* and *Tamarix chinensis* are primarily concentrated at zones of high salt marshes. Other plant species, including *Limonium sinense*, and *Salicomia europaea,* occur sparsely in small patches (Cui et al. 2011). Meanwhile, exotic *S. alterniflora*, which has occupied most of the low marshes, is rapidly spreading landward along the tidal channel margins (Fig. S1 and S2).

Remote sensing analysis has showed that approximately 545.80 km^2 of *S. alterniflora* was distributed along the coastlines of mainland China before 2015 (Liu et al. 2018). In the Yellow River Delta National Nature Reserve of northern China, *S. alterniflora* has occupied most mudflats, low marshes, and middle marshes, nearly an area of 4.38 km^2 (Cui et al. 2012, Liu et al. 2018). Currently, it is rapidly spreading from low marshes to high marshes along the tidal channel margins by means of its highly reproductive success (Ning et al. 2019).

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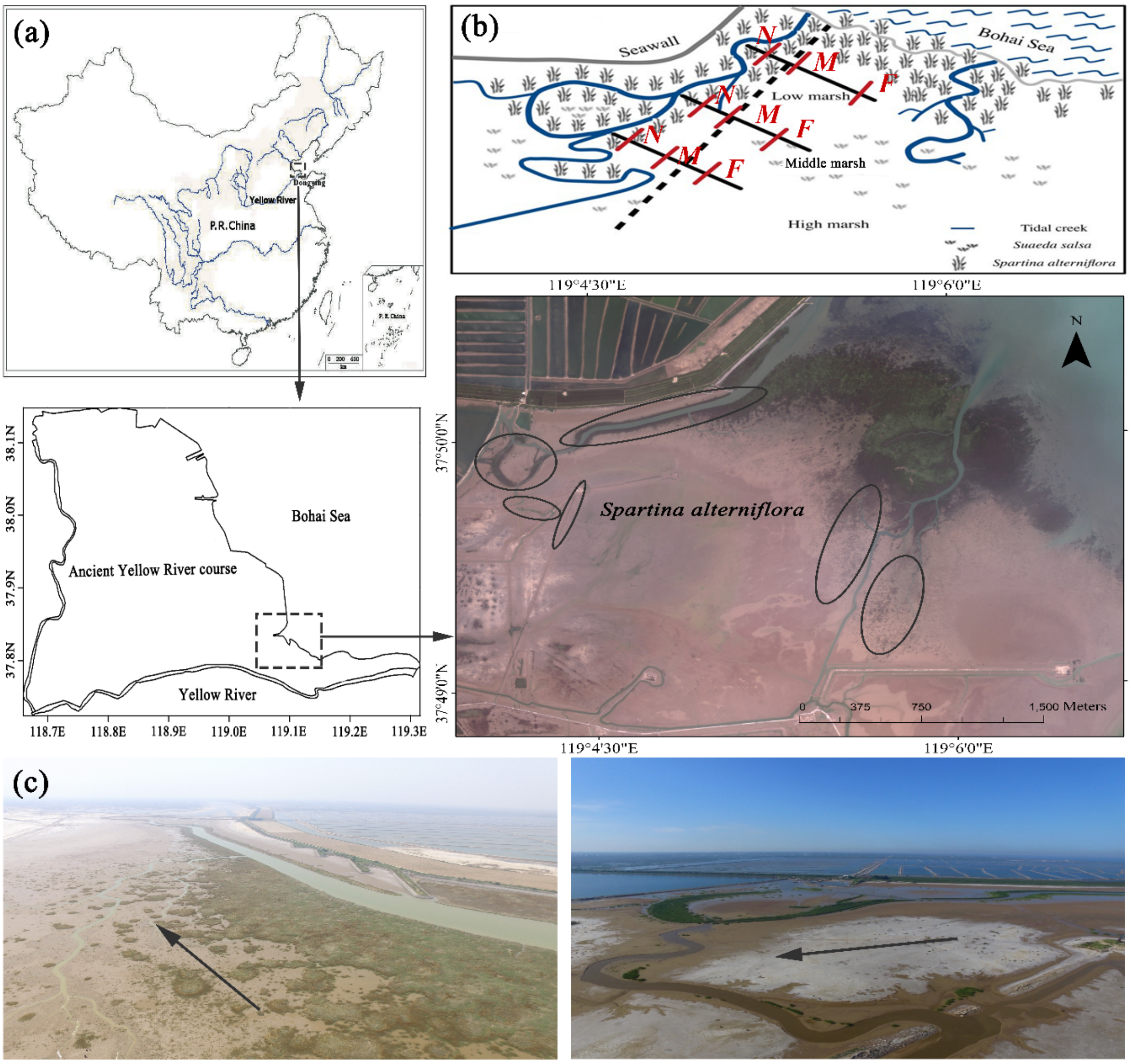

Fig. S1 Images of the study sites and sampling plots: (a) location of the Yellow River delta; (b) map of the study site. The study area was mapped based on the remote sensing image data purchased from Gaofen-2, using ArcGIS 10.3 software (Esri China Information Technology Co. Ltd., Hong Kong, China). N = near creek zone (0 m, at the border of *S. alterniflora* belt); M = middle zone (50 m after the border of *S. alterniflora* belt); F = Far from creek zone (200 m after the border of *S. alterniflora* belt). The black circles indicate the spatial pattern of *S. alterniflora* expansion along the tidal channel margins; (c) field photographs showing the landward invasion of *S. alterniflora* along the tidal channel margins. The black arrows indicate the landward direction. Photo credit: Z. H. Ning.

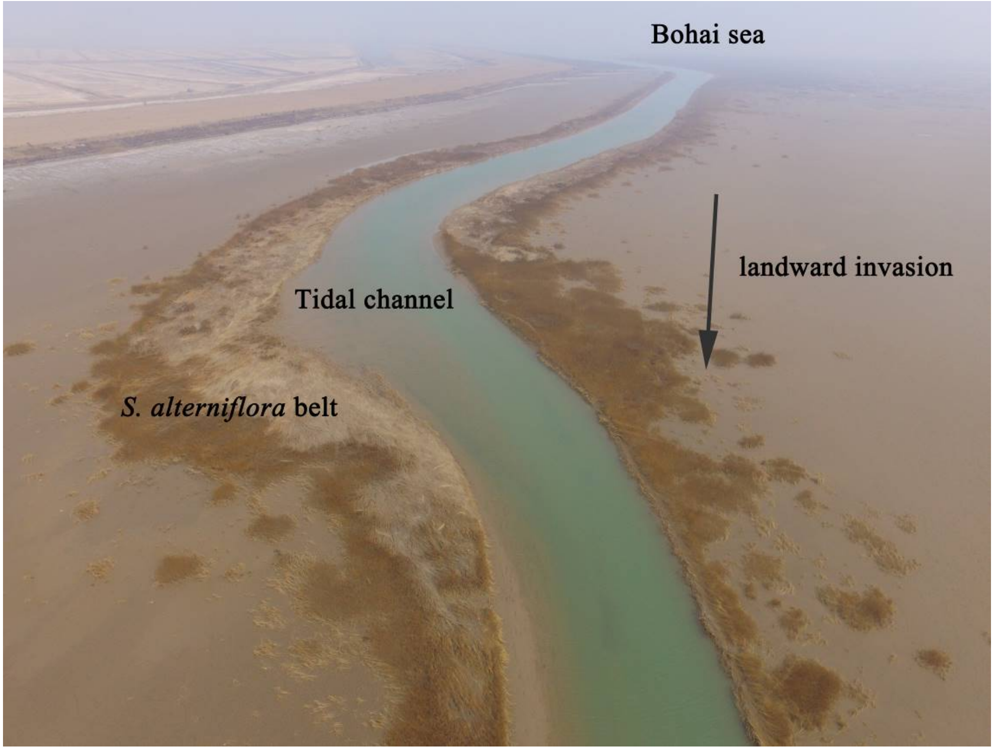

Fig. S2 Aerial photography showing the spatial pattern of the landward invasion of *S. alterniflora* spreading from low marshes to high salt marshes along the tidal channel margins. The black arrow indicates the landward invasion of *S. alterniflora*. Photo credit: Z. H. Ning.

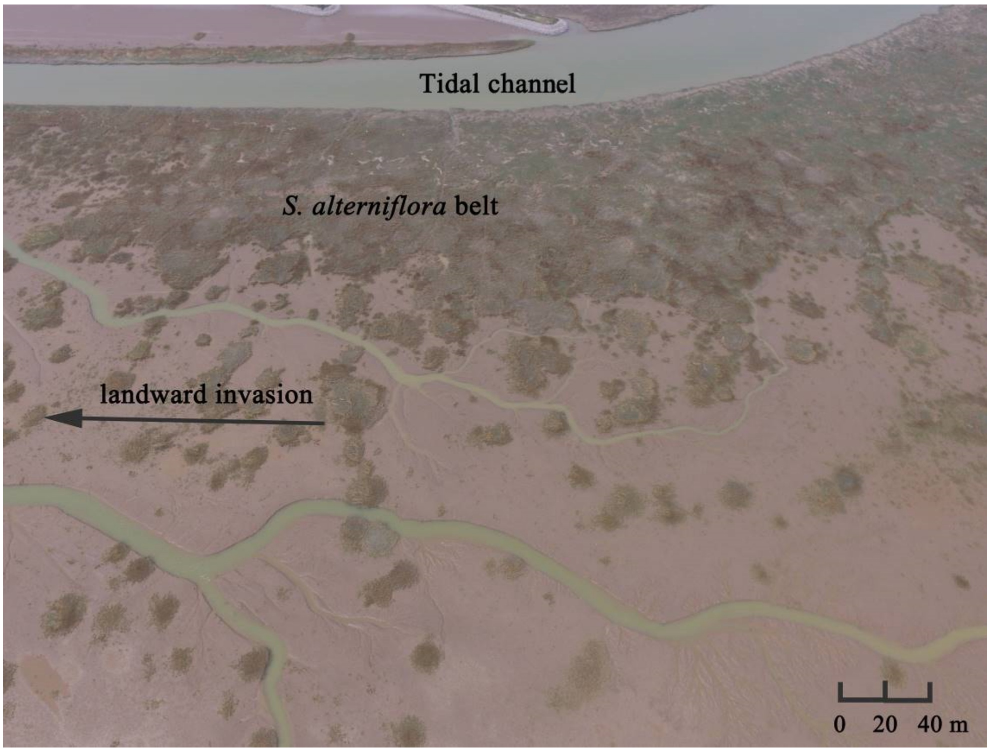

Fig. S3 Example of an aerial photography by UAV showing invasive *S. alterniflora* expanding at the margins of tidal channels. The black arrow indicates the landward direction. Photo credit: Z. H. Ning.

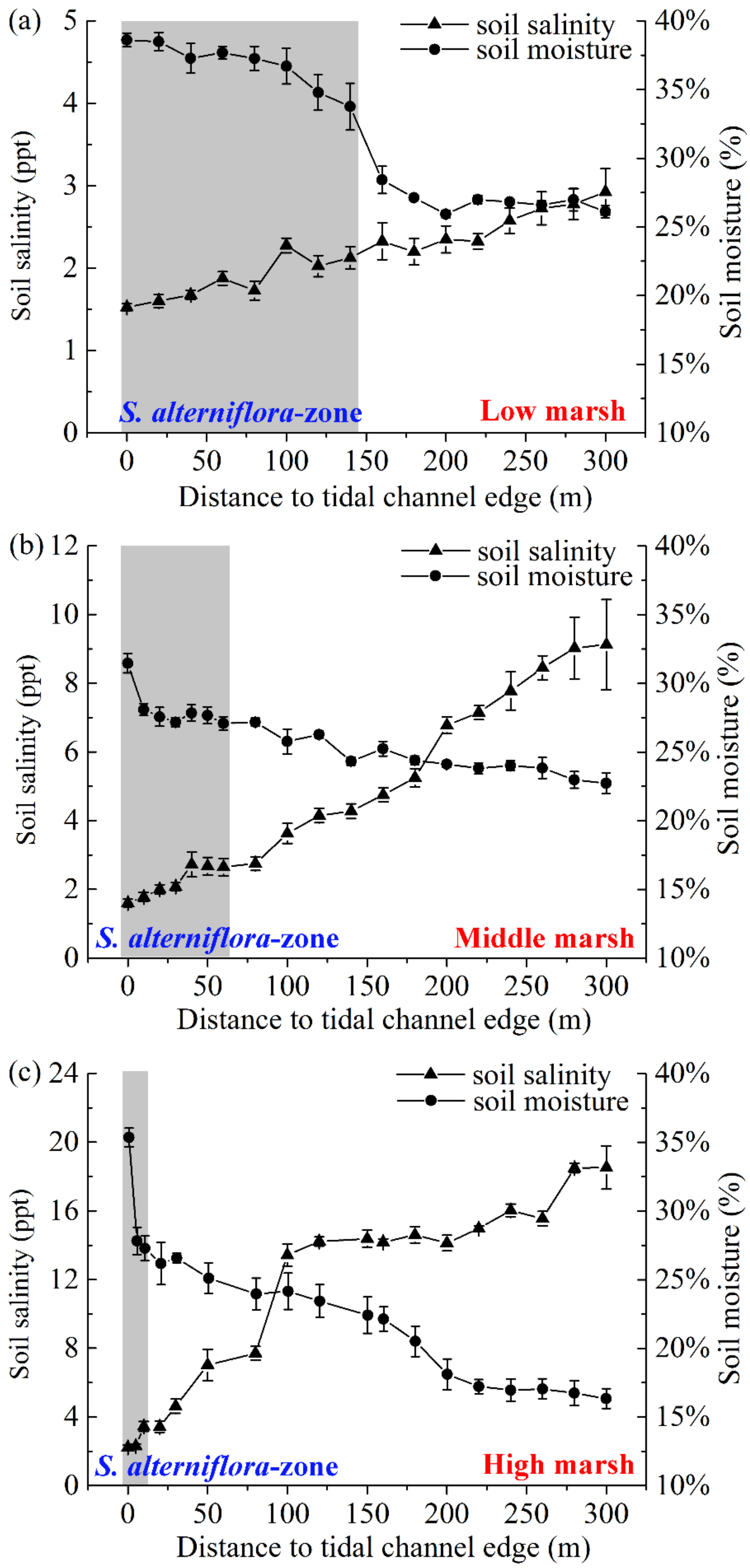

Fig. S4 Variations of soil salinity and soil moisture on lateral distance gradient of tidal channel margins in low marsh (a), middle marsh (b), and high marsh (c). Data are Mean ± SE (n = 4 replicates). Light gray rectangle in each subfigure indicates the average width of the *S. alterniflora* expansion belt in each elevational marsh zone (i.e., low marsh, middle marsh, and high marsh).

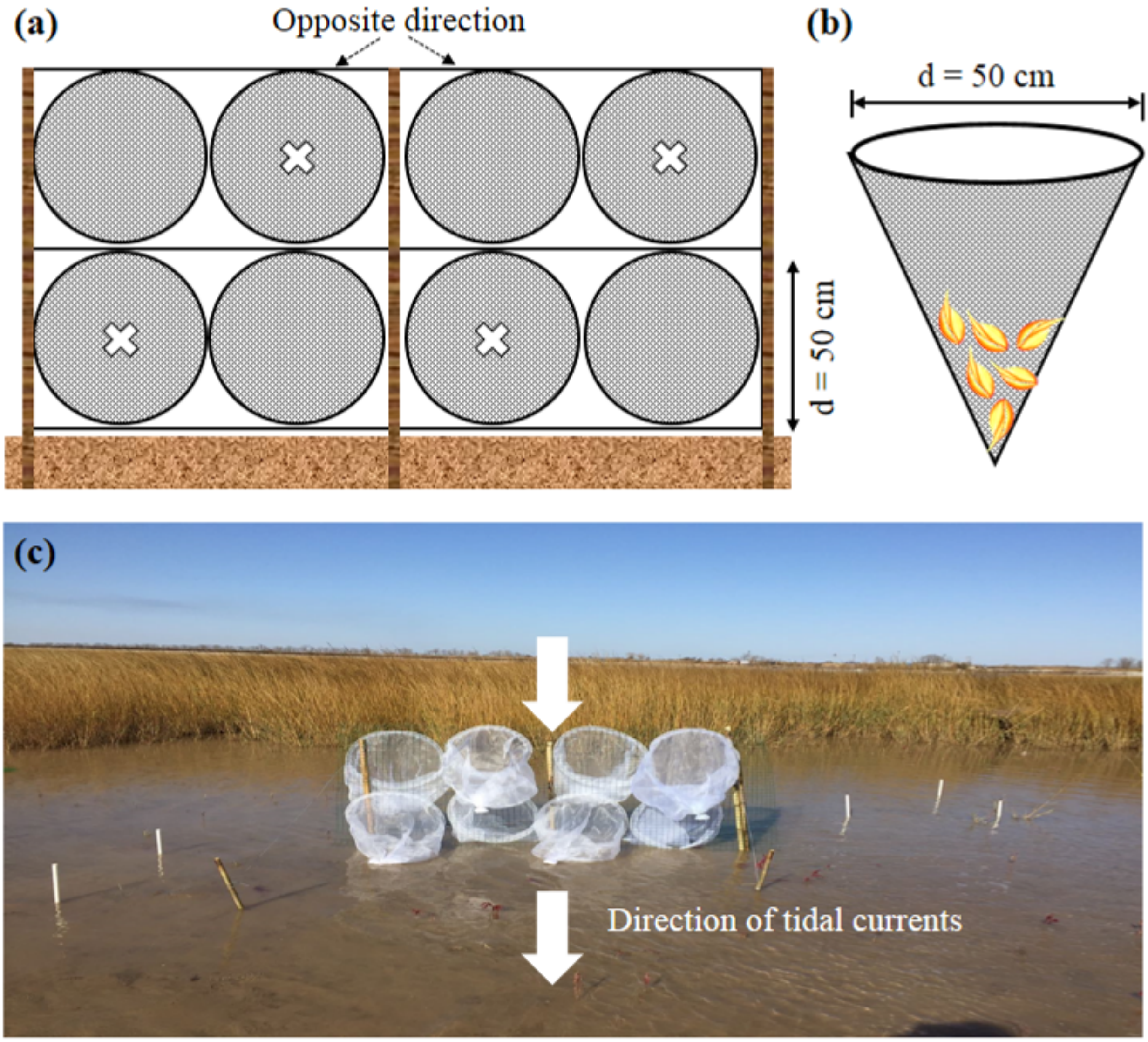

Fig. S5 *S. alterniflora* seed trap situated at the tidal channel margins: (a) overall structure of the *S. alterniflora* seed trap; (b) structure of the tapered nylon net bag using in the *S. alterniflora* seed trap; (c) field photo of the *S. alterniflora* seed trap. Photo credit: Z. H. Ning.

Table S1. Physical characteristics and *S. alterniflora* spatial distributions at different sampling sites along the tidal channel margins. Data are means ± SE.

	Low marsh			Middle marsh			High marsh		
	N	M	F	N	M	F	N	M	F
Soil salinity (ppt)	2.2 (0.1)	2.2 (0.1)	2.5 (0.1)	2.7 (0.2)	4.6 (0.1)	7.4 (0.3)	2.9 (0.3)	7.6 (0.3)	16.0 (0.5)
Soil moisture (%)	34.7 (0.6)	31.8 (1.1)	28.6 (1.1)	28.7 (1.1)	25.0 (0.7)	21.5 (0.6)	26.7 (0.5)	23.7 (0.5)	17.2 (0.4)
Elevation (m)	0.56 (0.0)	0.57 (0.0)	0.59 (0.0)	0.55 (0.0)	0.63 (0.0)	0.85 (0.0)	0.58 (0.0)	0.84 (0.0)	1.0 (0.0)
Inundation time (h/d)	19.9 (0.8)	19.0 (0.8)	18.4 (0.6)	19.9 (0.9)	13.6 (0.8)	5.6 (0.9)	17.0 (0.7)	6.5 (0.8)	3.9 (0.7)
Flooding frequency (%)	100 (0)	100 (0)	100 (0)	100 (0)	100 (0)	48.5 (1.4)	100 (0)	52.6 (3.1)	19.3 (0.5)
Lateral expansion width of *S. alterniflora* (m)		149.4 (2.7)			61.6 (1.6)			13.4 (1.1)	

Table S2. Summary of the GLMs results for the seed capture and soil seed density of *S. alterniflora* among three transplanting distances from the tidal channel (i.e., N, M, F) in three different salt marsh zones (i.e., low marsh, middle marsh and high marsh). ***, $P < 0.001$; **, $P < 0.01$; and *, $P < 0.05$.

Variable	Source	df	Wald χ^2	*P*
Seed capture	Zone	2	146.32	< 0.001***
	Distance	2	82.13	< 0.001***
	Zone×Distance	4	44.01	< 0.001***
Soil seed density	Zone	2	278.84	< 0.001***
	Distance	2	211.66	< 0.001***
	Zone×Distance	4	99.91	< 0.001***

Table S3. Summary of the GLMs results for the number of stems, maximum stem height, number of inflorescences and the total biomass of *S. alterniflora* among three transplanting distances from the tidal channel (i.e., N, M, F) in three different salt marsh zones (i.e., low marsh, middle marsh and high marsh). ***, $P < 0.001$; **, $P < 0.01$; and *, $P < 0.05$.

Form	Variable	Source	df	Wald χ^2	*P*
Tiller	Number of stems	Zone	2	89.09	< 0.001***
		Distance	2	228.73	< 0.001***
		Zone×Distance	4	58.11	< 0.001***
	Maximum stem height	Zone	2	608.21	< 0.001***
		Distance	2	658.15	< 0.001***
		Zone×Distance	4	486.60	< 0.001***
	Number of inflorescences	Zone	2	56.38	< 0.001***
		Distance	2	74.38	< 0.001***
		Zone×Distance	4	42.53	< 0.001***
	Total Biomass	Zone	2	186.58	< 0.001***
		Distance	2	151.61	< 0.001***
		Zone×Distance	4	72.96	< 0.001***
Seedling	Number of stems	Zone	3	116.77	< 0.001***
		Distance	3	85.33	< 0.001***
		Zone×Distance	4	44.75	< 0.001***
	Maximum stem height	Zone	2	89.81	< 0.001***
		Distance	2	79.24	< 0.001***
		Zone×Distance	4	56.34	< 0.001***
	Number of inflorescences	Zone	2	155.30	< 0.001***
		Distance	2	151.28	< 0.001***
		Zone×Distance	4	78.73	< 0.001***
	Total Biomass	Zone	2	132.31	< 0.001***
		Distance	2	111.13	< 0.001***
		Zone×Distance	4	48.88	< 0.001***

Table S4. Result of linear regression models for *S. alterniflora* standing biomass growing from transplanted tillers in different salt marsh zones along the tidal channel margins. Bold = $P < 0.05$, sign = sign of regression coefficient.

Location	Value	Soil salinity	Soil moisture	Flooding frequency	Inundation time	Elevation
Low marsh	R^2	0.00	0.08	NA	0.01	0.01
	P	0.99	0.75	NA	0.61	0.88
	Sign	-	+	NA	+	-
Middle marsh	R^2	**0.83**	**0.53**	**0.67**	**0.85**	**0.85**
	P	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
	Sign	-	+	+	+	-
High marsh	R^2	**0.73**	**0.69**	**0.73**	**0.62**	**0.70**
	P	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
	Sign	-	+	+	+	-
Overall marshes	R^2	**0.70**	**0.59**	**0.71**	**0.73**	**0.80**
	P	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
	Sign	-	+	+	+	-

Table S5. Result of linear regression models for number of *S. alterniflora* growing from transplanted tillers in different salt marsh zones along the tidal channel margins. Bold = $P < 0.05$, sign = sign of regression coefficient.

Location	Value	Soil salinity	Soil moisture	Flooding frequency	Inundation time	Elevation
Low marsh	R^2	0.03	0.13	NA	**0.15**	**0.21**
	P	0.42	0.05	NA	0.04	0.01
	Sign	-	+	NA	+	-
Middle marsh	R^2	**0.67**	**0.54**	**0.62**	**0.76**	**0.78**
	P	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
	Sign	-	+	+	+	-
High marsh	R^2	**0.79**	**0.67**	**0.90**	**0.85**	**0.91**
	P	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
	Sign	-	+	+	+	-
Overall marshes	R^2	**0.70**	**0.55**	**0.77**	**0.76**	**0.83**
	P	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
	Sign	-	+	+	+	-