Supplementary material

Salvaging and replanting 300 mangrove trees and saplings in the arid Arabian Gulf

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Results of statistical analyses

Table S1. PERMANOVA results 3 factor design assessing the factors Time (Ti), Treatment (Tr) and Plot (Pl) (random, nested within Treatment) for differences within the variables, height, leaf health and survival across the 12.5-month experiment

Bold values indicate a significant result ($P < 0.05$)

Source	d.f.	MS	Pseudo-F	P_{perm}
Plant height				
Tr	4	1340.9	0.063569	0.9969
Ti	3	944.87	2.4915	0.0566
Pl(Tr)	5	24947	65.783	**<0.001**
Tr × Ti	12	476.37	1.2561	0.2361
Res	726	379.24		
Total	750			
Leaf Health				
Tr	4	38279	8.6714	**0.0293**
Ti	3	8290.6	18.175	**<0.001**
Pl(Tr)	5	5150.8	11.292	**<0.001**
Tr × Ti	12	1227.3	2.6906	**0.0018**
Res	726	456.15		
Total	750			
Survivorship				
Tr	3	5.1575	10.064	**0.0207**
Ti	3	12.103	144.04	**<0.001**
Pl(Tr)	6	0.50303	5.9866	**<0.001**
Tr × Ti	12	0.80422	9.571	**<0.001**
Res	2740	0.084027		
Total	2766			

Table S2. Pairwise tests for the interaction between the factors Treatment × Time (Treatment) for the variables leaf health and survival

Treatments involved exposure to different levels of tidal inundation ('high' v. 'low') and daily watering with freshwater (2 L v. 6 L). Bold values indicate a significant result ($P < 0.05$). Asterisks (*) indicate Monte-Carlo Bootstrapping was used to determine a suitable P-value ($P < 0.05$) (P_{perm})

Leaf Health – Treatment Groups	t	P_{perm}	Survivorship – Treatment Groups	t	P_{perm}
1 week					
Low 6 L, Low 2 L	1.9057	0.1873*	Control, Low 6 L	4.1866	0.0547*
Low 6 L, High 6 L	2.0002	0.183*	Control, Low 2 L	9.968	**0.0112***
Low 6 L, High 2 L	5.9388	**0.0256***	Control, High 6 L	1.7951	0.2136*
Low 6 L, Control	8.9175	**0.0104***	Control, High 2 L	1.081	0.3917*
Low 2 L, High 6 L	1.1206	0.3882*	Low 6 L, Low 2 L	2.9673	0.0944*
Low 2 L, High 2 L	11.787	**0.0015***	Low 6 L, High 6 L	1.115	0.3857*
Low 2 L, Control	11.746	**0.002***	Low 6 L, High 2 L	2.2482	0.1468*
High 6 L, High 2 L	0.65271	0.5799*	Low 2 L, High 6 L	3.6632	0.0717*
High 6 L, Control	2.3135	0.1425*	Low 2 L, High 2 L	5.5066	**0.0242***
High 2 L, Control	5.4357	**0.0294***	High 6 L, High 2 L	0.79129	0.5084*
3 months					
Low 6 L, Low 2 L	1.2648	0.3323*	Control, Low 6 L	7.4537	**0.0186***
Low 6 L, High 6 L	1.483	0.2794*	Control, Low 2 L	59.169	**<0.001***
Low 6 L, High 2 L	3.2468	0.0791*	Control, High 6 L	23.84	**0.002***
Low 6 L, Control	6.7336	**0.0123***	Control, High 2 L	8.645	**0.0113***
Low 2 L, High 6 L	0.14224	0.9077*	Low 6 L, Low 2 L	0.02666	0.9786*
Low 2 L, High 2 L	1.8456	0.2042*	Low 6 L, High 6 L	0.52657	0.6555*
Low 2 L, Control	3.7485	**0.0474***	Low 6 L, High 2 L	2.1536	0.1636*
High 6 L, High 2 L	1.7736	0.2164*	Low 2 L, High 6 L	2.2348	0.1454*
High 6 L, Control	3.6835	**0.0475***	Low 2 L, High 2 L	4.7353	0.0324*
High 2 L, Control	0.43459	0.7076*	High 6 L, High 2 L	3.2427	0.0775*
7 months					
Low 6 L, Low 2 L	1.0875	0.3801*	Control, Low 6 L	4.5847	**0.0442***
Low 6 L, High 6 L	0.74512	0.5186*	Control, Low 2 L	19.498	**0.0033***
Low 6 L, High 2 L	5.9985	**<0.001***	Control, High 6 L	45.825	**<0.001***
Low 6 L, Control	6.7102	**<0.001***	Control, High 2 L	8.6262	**0.01***
Low 2 L, High 6 L	0.004918	0.9974*	Low 6 L, Low 2 L	0.14991	0.8935*
Low 2 L, High 2 L	1.536	0.2616*	Low 6 L, High 6 L	0.68406	0.5638*
Low 2 L, Control	3.2731	**0.0456***	Low 6 L, High 2 L	1.4764	0.2864*
High 6 L, High 2 L	1.0261	0.4034*	Low 2 L, High 6 L	3.5754	0.0693*
High 6 L, Control	2.2958	0.1342*	Low 2 L, High 2 L	4.3625	**0.0429***
High 2 L, Control	3.4637	**0.0172***	High 6 L, High 2 L	2.7917	0.1047*
12.5 months					
Low 6 L, Low2 L	0.79429	0.493*	Control, Low 6 L	3.2717	0.1909*
Low 6 L, High 6 L	2.0271	0.1558*	Control, Low 2 L	5.5815	0.1165*
Low 6 L, High 2 L	2.7062	0.1007*	Control, High 6 L	9.2992	0.067*
Low 6 L, Control	1.5516	0.3727*	Control, High 2 L	5.1081	0.1231*
Low 2 L, High 6 L	2.2641	0.1432*	Low 6 L, Low 2 L	0.40566	0.7292*
Low 2 L, High 2 L	2.9838	0.0898*	Low 6 L, High 6 L	1.3155	0.3158*
Low 2 L, Control	5.0303	0.1231*	Low 6 L, High 2 L	2.5687	0.1254*
High 6 L, High 2 L	0.74322	0.5384*	Low 2 L, High 6 L	1.5342	0.2661*
High 6 L, Control	0.96904	0.5524*	Low 2 L, High 2 L	3.6763	0.0581*
High 2 L, Control	0.3371	0.9045*	High 6 L, High 2 L	3.5317	0.0673*

Table S3. Permanova tables investigating the relationship of the factors *Time* (Ti), *Bed-level* (Be), *Watering* (Wa) and *Plot* (Pl) (random, nested within *Bed level* and *Watering*) within the variables leaf health and survival

Bold values indicate a significant result ($P < 0.05$)

Source	d.f.	MS	Pseudo-F	P_{perm}
Survival				
Ti	3	13.889	72.055	**<0.001**
Be	1	12.862	17.247	**0.0262**
Wa	1	0.67814	0.90933	0.4359
Ti × Be	3	0.15987	0.8294	0.4718
Ti × Wa	3	0.51545	2.6742	**0.0413**
Be × Wa	1	2.9447	3.9486	0.1907
Pl(Be × Wa)	4	0.75455	3.9146	**0.0044**
Ti × Be × Wa	3	0.14512	0.75286	0.518
Res	1151	0.19275		
Total	1170			
Leaf Health				
Ti	3	8515.3	15.338	**<0.001**
Be	1	46584	9.3904	**0.0241**
Wa	1	16334	3.2925	0.1419
Ti × Be	3	606.8	1.093	0.3496
Ti × Wa	3	1885	3.3955	**0.0218**
Be × Wa	1	546.05	0.11007	0.7877
Pl(Be × Wa)	4	5984.3	10.779	**<0.001**
Ti × Be × Wa	3	385.6	0.69458	0.5533
Res	464	555.16		
Total	483			

Table S4. Pairwise tests for the factor Bed-level (High, i.e. shallow plots, and Low, i.e. deep plots) within the variables leaf health and survival

Bold values indicate a significant result ($P < 0.05$)

Groups	T	P_{perm}
Survival		
Low, High	4.1529	**0.0275**
Leaf Health		
Low, High	3.0644	**0.0281**

Table S5. PERMANOVA results 4 factor design assessing the factors Time (Ti), Treatment (Tr), Plant height (Si) and Plot (Pl) (random, nested within Treatment) for differences within the variables leaf health and survival across the 12.5-month experiment

Bold values indicate a significant result ($P < 0.05$)

Source	d.f.	MS	Pseudo-F	P_{perm}
Leaf Health				
Tr	4	12654	9.4612	**0.0164**
Ti	3	3499.2	4.8087	**0.0241**
Si	3	345.86	1.0679	0.4226
Pl(Tr)	5	1262.2	2.9764	**0.0111**
Tr × Ti	12	1131.6	1.2817	0.3459
Tr × Si	12	1223.9	4.215	**0.0462**
Ti × Si	9	125.53	0.29602	0.9739
Ti × Pl(Tr)	14	870.06	2.0518	**0.0156**
Si × Pl(Tr)	10	288.67	0.68075	0.7287
Tr × Ti × Si	31	567.88	1.3392	0.1086
Res	646	424.05		
Total	749			
Survival				
Tr	4	1.8602	15.863	**0.001**
Ti	3	4.1418	24.422	**<0.001**
Si	3	0.66446	2.6221	0.1386
Pl(Tr)	5	0.11642	0.87165	0.4997
Tr × Ti	12	0.44245	2.4782	0.072
Tr × Si	12	0.40304	1.3971	0.3316
Ti × Si	9	0.15146	1.134	0.3353
Ti × Pl(Tr)**	14	0.20819	1.5588	0.0876
Si × Pl(Tr)**	10	0.3491	2.6138	**0.0034**
Tr × Ti × Si**	34	0.10164	0.76099	0.8321
Res	1121	0.13356		
Total	1227			

Table S6. Pairwise tests for the interaction between the factors Treatment × Time (Time) for the variables leaf health and survival

Bold values indicate a significant result ($P < 0.05$). Asterisks (*) indicate Monte-Carlo Bootstrapping was used to determine a suitable P-value ($P < 0.05$) (P_{perm})

Leaf Health – Time			Survivorship – Time		
Groups	t	P_{perm}	Groups	t	P_{perm}
Control					
1 wk, 3	2.1181	**0.0369**	1 wk, 3	0.99992	0.528
1 wk, 7	3.031	**0.0022**	1 wk, 7	1.0001	0.5231
1 wk, 12.5	0.19329	0.8479	1 wk, 12.5	3.8079	**<0.001**
3, 7	1.3302	0.1917	3, 7	Negative	
3, 12.5	1.0251	0.3045	3, 12.5	3.1039	**0.0014**
7, 12.5	1.8138	0.0699	7, 12.5	3.5474	**<0.001**
Low 5 L					
1 wk, 3	0.77038	0.4484	1 wk, 3	6.9014	**<0.001**
1 wk, 7	0.24208	0.819	1 wk, 7	7.286	**<0.001**
1 wk, 12.5	3.6631	**<0.001**	1 wk, 12.5	8.8895	**<0.001**
3, 7	0.15502	0.8793	3, 7	0.24147	0.8099
3, 12.5	4.1698	**<0.001**	3, 12.5	1.4414	0.1557
7, 12.5	2.7584	**0.011**	7, 12.5	1.2572	0.2171
Low 1 L					
1 wk, 3	0.1963	0.8418	1 wk, 3	3.3536	**0.0014**
1 wk, 7	0.47063	0.6349	1 wk, 7	3.9612	**<0.001**
1 wk, 12.5	1.8351	0.0693	1 wk, 12.5	3.9222	**<0.001**
3, 7	0.095927	0.9192	3, 7	0.55831	0.5841
3, 12.5	1.3719	0.1777	3, 12.5	0.52184	0.6214
7, 12.5	1.1258	0.2635	7, 12.5	0.031756	0.9735
High 5 L					
1 wk, 3	1.8162	0.07	1 wk, 3	7.6174	**<0.001**
1 wk, 7	2.2776	**0.0281**	1 wk, 7	6.8764	**<0.001**
1 wk, 12.5	3.1781	**0.0022**	1 wk, 12.5	7.3481	**<0.001**
3, 7	0.37521	0.7124	3, 7	0.52578	0.6173
3, 12.5	4.136	**<0.001**	3, 12.5	0.16878	0.8778
7, 12.5	4.4457	**<0.001**	7, 12.5	0.35134	0.7407
High 1 L					
1 wk, 3	2.452	**0.0143**	1 wk, 3	5.9759	**<0.001**
1 wk, 7	0.6098	0.538	1 wk, 7	5.9759	**<0.001**
1 wk, 12.5	4.4964	**<0.001**	1 wk, 12.5	6.1806	**<0.001**
3, 7	2.58	**0.0119**	3, 7	Negative	
3, 12.5	1.5788	0.1229	3, 12.5	0.17687	0.876
7, 12.5	4.7584	**<0.001**	7, 12.5	0.17687	0.8765

Table S7. Pairwise tests for the interaction between the factors Treatment × Size class (Size class) for the variable leaf health.

Bold values indicate a significant result ($P < 0.05$). Asterisks (*) indicate Monte-Carlo Bootstrapping was used to determine a suitable P-value ($P < 0.05$) (P_{perm})

Leaf health Groups (cm)	t	P_{perm}
Control		
0–30, 31–60	0.12914	0.933*
0–30, 61–90	1.0797	0.4696*
0–30, >91	1.5664	0.1216
31–60, 61–90	4.1859	0.1169*
31–60, >91	5.0581	**<0.001**
61–90, >91	3.075	**0.0038**
Low 2 L		
0–30, 31–60	1.0474	0.5496*
0–30, 61–90	2.5708	0.1491*
0–30, >91	No test, d.f. = 0	
31–60, 61–90	0.25959	0.825*
31–60, >91	0.25911	0.8072*
61–90, >91	3.4294	0.1864*
High 2 L		
0–30, 31–60	0.27062	0.8596*
0–30, 61–90	1.0746	0.4571*
0–30, >91	1.412	0.198
31–60, 61–90	0.22376	0.8281*
31–60, >91	1.8874	0.0632
61–90, >91	2.5617	**0.0163**
High 6 L		
0–30, 31–60	0.89547	0.3757
0–30, 61–90	No test, d.f. = 0	
0–30, >91	No test, d.f. = 0	
31–60, 61–90	2.3587	**0.0199***
31–60, >91	1.4383	0.1577
61–90, >91	0.89088	0.3781
Low 6 L		
0–30, 31–60	1.4026	0.2781*
0–30, 61–90	1.2881	0.2236*
0–30, >91	1.3118	0.2122
31–60, 61–90	1.4864	0.2688*
31–60, >91	3.0055	**0.0038**
61–90, >91	2.1566	**0.0409**

Table S8. Pairwise tests for the interaction between the factors Treatment × Size class (Treatment) for the variable leaf health

Treatments involved exposure to different levels of tidal inundation ('high' *v.* 'low') and daily watering with freshwater (2 L *v.* 6 L). Bold values indicate a significant result ($P < 0.05$). Asterisks (*) indicate Monte-Carlo Bootstrapping was used to determine a suitable *P*-value ($P < 0.05$) (P_{perm})

Leaf health Groups	t	P_{perm}
0–30 cm		
Control, Low 2 L	3.0131	**0.0307***
Control, High 2 L	0.95842	0.3966*
Control, High 6 L	2.6942	0.1343*
Control, Low 6 L	4.8536	**<0.001***
Low 2 L, High 2 L	0.95048	0.4333*
Low 2 L, High 6 L	1.1213	0.4984*
Low 2 L, Low 6 L	0.25445	1*
High 2 L, High 6 L	0.33391	0.985*
High 2 L, Low 6 L	1.3719	0.2469*
High 6 L, Low 6 L	4.4557	0.133*
31–60 cm		
Control, Low 2 L	8.6962	**<0.001***
Control, High 2 L	0.55842	0.6204*
Control, High 6 L	2.0211	0.1183*
Control, Low 6 L	12.87	**<0.001***
Low 2 L, High 2 L	5.3015	**0.0224***
Low 2 L, High 6 L	2.9907	0.0882*
Low 2 L, Low 6 L	4.9792	**0.0388***
High 2 L, High 6 L	1.164	0.3643*
High 2 L, Low 6 L	8.1986	**0.0078***
High 6 L, Low 6 L	5.4025	**0.0302***
61–90 cm		
Control, Low 2 L	2.5803	0.1239*
Control, High 2 L	2.6878	0.0728*
Control, High 6 L	1.4354	0.2871*
Control, Low 6 L	5.9625	**0.0146***
Low 2 L, High 2 L	1.4439	0.2684*
Low 2 L, High 6 L	0.42718	0.7165*
Low 2 L, Low 6 L	0.65422	0.5813*
High 2 L, High 6 L	0.62439	0.5925*
High 2 L, Low 6 L	3.7293	**0.0206***
High 6 L, Low 6 L	1.0428	0.4013*
>91 cm		
Control, Low 2 L	2.2714	0.269*
Control, High 2 L	8.0979	**<0.001**
Control, High 6 L	9.9335	**<0.001**
Control, Low 6 L	8.4118	**<0.001**
Low 2 L, High 2 L	1.0499	0.6202*
Low 2 L, High6 L	0.88809	0.7355*
Low 2 L, Low 6 L	1.1162	0.4608*
High 2 L, High 6 L	0.61853	0.545
High 2 L, Low 6 L	0.83607	0.432
High 6 L, Low 6 L	1.7242	0.0947

Table S9. Pairwise test for the factor Treatment (High 6 L, High 2 L, Low 6 L, Low 2 L and Control) within the variables leaf health and survival

Treatments involved exposure to different levels of tidal inundation ('high' v. 'low') and daily watering with freshwater (2 L v. 6 L). Bold values indicate a significant result ($P < 0.05$). Asterisks (*) indicate Monte-Carlo Bootstrapping was used to determine a suitable P-value ($P < 0.05$) (P_{perm})

Leaf Health Groups	t	P_{perm}	Survivorship Groups	t	P_{perm}
Treatment			Treatment		
Low 6 L, Low 2 L	1.7327	0.1992*	Control, Low 6 L	No test, d.f. = 0	
Low 6 L, High 6 L	1.4916	0.2716*	Control, Low 2 L	No test, d.f. = 0	
Low 6 L, High 2 L	10.146	**0.0019***	Control, High 6 L	No test, d.f. = 0	
Low 6 L, Control	12.115	**0.0013***	Control, High 2 L	No test, d.f. = 0	
Low 2 L, High 6 L	0.63246	0.5958*	Low 6 L, Low 2 L	0.61888	0.5982*
Low 2 L, High 2 L	3.9491	0.0529*	Low 6 L, High 6 L	1.3868	0.3059*
Low 2 L, Control	5.8547	**0.0224***	Low 6 L, High 2 L	2.7095	0.1079*
High 6 L, High 2 L	1.2739	0.3331*	Low 2 L, High 6 L	4.2225	0.0529*
High 6 L, Control	2.2653	0.1529*	Low 2 L, High 2 L	4.9723	**0.0383***
High 2 L, Control	2.2043	0.1509*	High 6 L, High 2 L	2.9225	0.0967*