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*Supplement of*

## **Sediment properties and CO<sub>2</sub> efflux from intact and cleared temperate mangrove forests**

**R. H. Bulmer et al.**

*Correspondence to:* R. H. Bulmer (bulmer.richard@gmail.com)

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## Supplementary material

Supplementary Table 1: CO<sub>2</sub> efflux (mmol m<sup>-2</sup> d<sup>-1</sup>) before and after surface biofilm removal, at individual intact and cleared mangrove forest sites (n = 3), mean ± SE. Small clearance size < 1 ha, large clearance size > 1 ha.

Region	Sub estuary	Longitude	Latitude	Time since clearance (yr <sup>-1</sup> )	Size of Clearance	Clearance Method	Site Hydro-dynamics	Carbon dioxide efflux: surface biofilm intact (mmol m <sup>-2</sup> d <sup>-1</sup> )		Carbon dioxide efflux: surface biofilm removal (mmol m <sup>-2</sup> d <sup>-1</sup> )	
								Intact mangrove forest	Cleared mangrove forest	Intact mangrove forest	Cleared mangrove forest
Northland	Hatea 1	35 43.569	174 19.743	0.1	Small	Unknown	Sheltered	-50.9 ± 57.0	-135.7 ± 47.5	837.2 ± 25.9	235.9 ± 61.3
Auckland	Waiuku 3	37 14.545	174 43.716	3	Small	Mechanical	Sheltered		406.9 ± 116.6		3055.0 ± 94.2
Auckland	Waiuku 2	37 14.653	174 43.793	3	Small	Mechanical	Sheltered		717.1 ± 261.8		224.6 ± 24.2
Auckland	Waiuku 1	37 14.756	174 43.823	3	Small	Mechanical	Sheltered		214.3 ± 7.8		275.6 ± 59.6
Auckland	Whangateau	36 20.634	174 45.676				Exposed	50.9 ± 20.7		127.0 ± 1.7	
Auckland	Mangere 1	36 55.934	174 47.222	0.1	Small	Manual	Sheltered	44.9 ± 11.2	193.5 ± 87.3	79.5 ± 16.4	101.9 ± 23.3
Auckland	Mangere 2	36 56.163	174 47.263	1	Small	Manual	Sheltered	142.6 ± 16.4	132.2 ± 81.2	209.1 ± 45.8	248.8 ± 25.1
Auckland	Panmure 2	36 54.429	174 50.714	5	Small	Manual	Sheltered	88.1 ± 25.1	93.3 ± 31.1	210.8 ± 21.6	174.5 ± 39.7
Auckland	Panmure 1	36 54.486	174 50.909	5	Small	Manual	Sheltered		12.1 ± 24.2		197.9 ± 12.1
Auckland	Pahurehure 1	37 02.638	174 54.335				Sheltered	83.8 ± 6.1		201.3 ± 21.6	
Auckland	Pahurehure 4	37 03.450	174 55.385	1	Large	Mechanical	Sheltered		344.7 ± 119.2		272.2 ± 76.0
Auckland	Pahurehure 3	37 03.280	174 55.556	1	Large	Mechanical	Sheltered		129.6 ± 13.8		268.7 ± 33.7
Auckland	Pahurehure 2	37 03.678	174 55.788	5	Large	Manual	Sheltered		44.9 ± 7.8		230.7 ± 19.0
Waikato	Tairua 2	37 00.762	175 50.812	3	Small	Manual	Exposed	212.5 ± 59.6	85.5 ± 4.3	210.8 ± 30.2	327.5 ± 36.3
Waikato	Tairua 3	37 01.754	175 50.976	3	Small	Manual	Exposed		-26.8 ± 6.9		176.3 ± 17.3
Waikato	Whangamata G	37 11.179	175 51.564	0.6	Large	Mechanical	Exposed	152.1 ± 47.5	68.3 ± 5.2	698.1 ± 71.7	281.7 ± 21.6
Waikato	Whangamata E	37 12.163	175 51.672	0.6	Large	Manual	Sheltered		120.9 ± 37.2		273.0 ± 108.9
Waikato	Whangamata E	37 12.093	175 51.722	0.6	Large	Mechanical	Sheltered		171.1 ± 86.4		199.6 ± 107.1
Waikato	Whangamata 1	37 11.983	175 51.898	6	Small	Manual/Mechanical	Sheltered		-41.5 ± 2.6		80.7 ± 7.8
Bay of Plenty	Uretara 2	37 32.277	175 55.457	6	Large	Manual	Sheltered		42.3 ± 26		88.1 ± 34.6
Bay of Plenty	Uretara 1	37 32.262	175 55.528	3	Large	Mechanical	Sheltered	210.8 ± 54.4	6.9 ± 36.3	359.4 ± 44.9	201.3 ± 17.3
Bay of Plenty	Welcome Bay 1	37 43.518	176 11.072	2	Large	Mechanical	Sheltered	227.2 ± 58.8	317.9 ± 54.4	363.7 ± 39.7	330.9 ± 143.4
Bay of Plenty	Waikaraka 1	37 39.986	176 3.840				Sheltered	128.7 ± 42.3		147.7 ± 58.8	
Bay of Plenty	Waikaraka 3	37 39.902	176 3.890	3	Small	Manual	Sheltered		45.8 ± 12.9		254.9 ± 113.2
Bay of Plenty	Waikaraka 2	37 40.093	176 3.928	3	Large	Mechanical	Sheltered		126.1 ± 99.4		225.5 ± 69.9
Bay of Plenty	Matua	37 40.322	176 7.540	8	Small	Manual	Sheltered	630.7 ± 139.9	18.1 ± 50.9	1044.6 ± 248.8	166.8 ± 36.3
Bay of Plenty	Waikareao	37 41.214	176 8.943				Exposed	273.0 ± 74.3		648 ± 28.5	
<b>Mean</b>								<b>168.5 ± 45.8</b>	<b>133.9 ± 37.2</b>	<b>394.8 ± 85.5</b>	<b>223.8 ± 14.7</b>

Supplementary Table 2: Sediment CO<sub>2</sub> efflux and site characteristics (mean ± SE) from intact mangrove sites where CO<sub>2</sub> efflux was higher than 168.5 mmol m<sup>-2</sup> d<sup>-1</sup> (high efflux group), compared to remaining intact mangrove sites where CO<sub>2</sub> efflux was lower (low efflux group). \* *significant difference (p < 0.05)*

	High efflux group (n = 5)	Low efflux group (n = 8)
Sediment CO <sub>2</sub> efflux (mmol m <sup>-2</sup> d <sup>-1</sup> )*	310.8 ± 80.7	80.1 ± 23.4
Mangrove biomass (kg dry weight m <sup>-2</sup> )	2.9 ± 0.7	5.3 ± 1.4
<i>Sediment characteristics</i>		
Organic carbon (%)	4.1 ± 0.7	3.3 ± 1.1
Nitrogen (%)	0.5 ± 0.1	0.4 ± 0.1
Gravel (%)	8.9 ± 5.3	0.5 ± 0.2
Sand (%)	39.7 ± 8.7	27.6 ± 13.5
Silt (%)	38.5 ± 8.0	53.1 ± 10.2
Clay (%)	12.9 ± 1.7	18.9 ± 4.1
Chlorophyll a (µg <sup>-1</sup> g <sup>-1</sup> sediment)*	53.3 ± 7.0	26.6 ± 7.0
Sediment temperature (°C)*	21.3 ± 1.0	17.9 ± 0.8

Supplementary Table 3: Sediment CO<sub>2</sub> efflux and site characteristics (mean ± SE) from cleared mangrove sites where CO<sub>2</sub> efflux was higher than 133.9 mmol m<sup>-2</sup> d<sup>-1</sup> (high efflux group), compared to remaining cleared mangrove sites where CO<sub>2</sub> efflux was lower (low efflux group). \* *significant difference* ( $p < 0.05$ )

	High efflux group (n = 7)	Low efflux group (n = 16)
Sediment CO <sub>2</sub> efflux (mmol m <sup>-2</sup> d <sup>-1</sup> )*	338.0 ± 71.3	45.2 ± 18.3
Time since clearance (yr <sup>-1</sup> )	1.8 ± 0.5	3.4 ± 0.6
Mangrove root mass (kg dry weight m <sup>-3</sup> )	11.8 ± 1.9	8.3 ± 1.1
Mangrove pneumatophore abundance (n m <sup>-2</sup> )	283.7 ± 102.3	354.5 ± 66.0
Crab burrow abundance (n m <sup>-2</sup> )	336.7 ± 232.0	222.6 ± 78.5
<i>Sediment characteristics</i>		
Organic carbon (%)*	4.2 ± 0.8	2.1 ± 0.4
Nitrogen (%)*	0.5 ± 0.1	0.3 ± 0.1
Gravel (%)	1.5 ± 0.4	1.6 ± 1.3
Sand (%)*	15.5 ± 9.9	43.0 ± 8.0
Silt (%)	54.9 ± 8.1	40.4 ± 6.5
Clay (%)*	28.2 ± 4.3	15.1 ± 2.6
Chlorophyll a (µg <sup>-1</sup> g <sup>-1</sup> sediment)	34.2 ± 10.7	23.6 ± 4.2
Sediment temperature (°C)	20.3 ± 0.7	20.1 ± 0.6