

Management & climate – Impacts on Carbon & Water

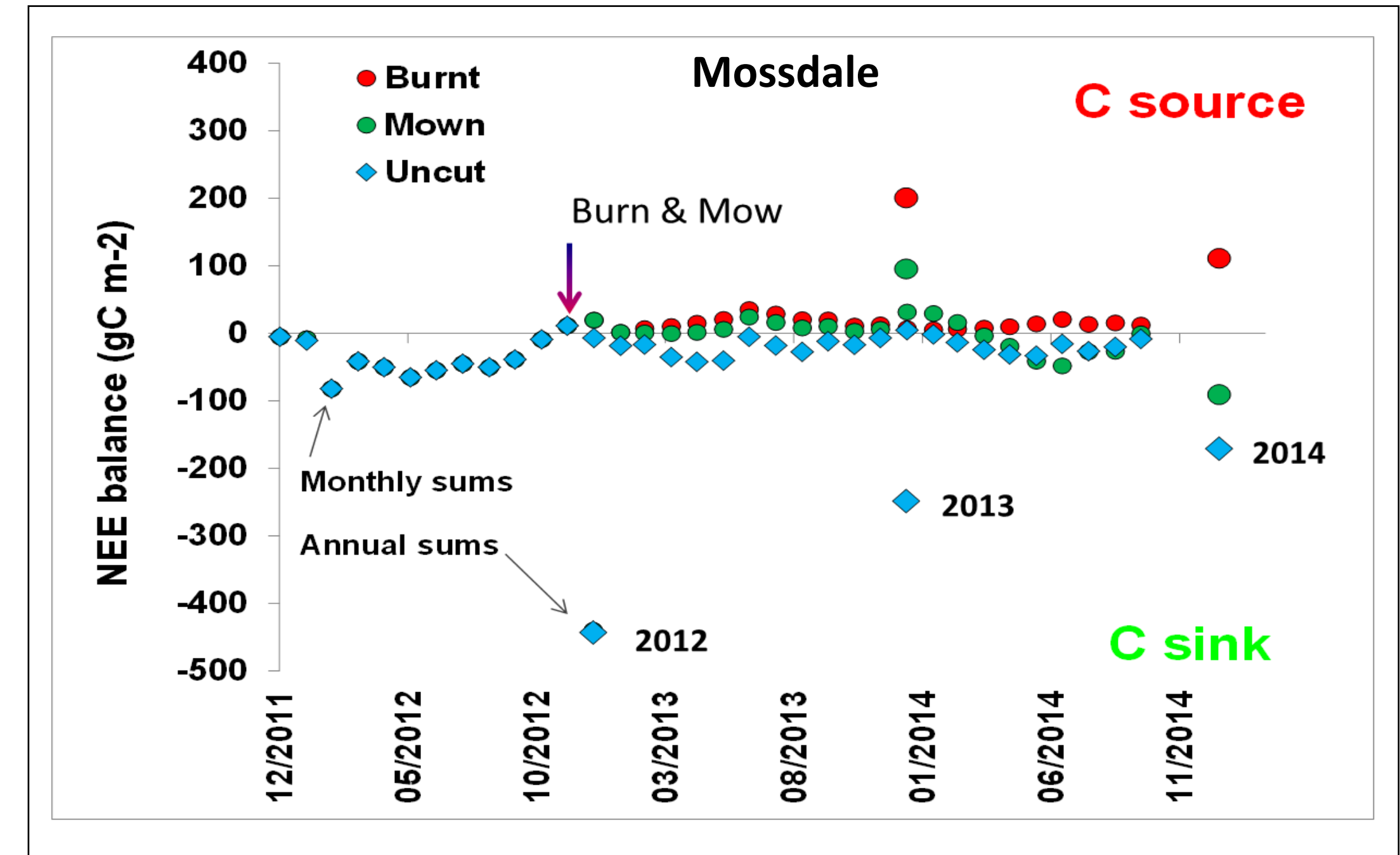
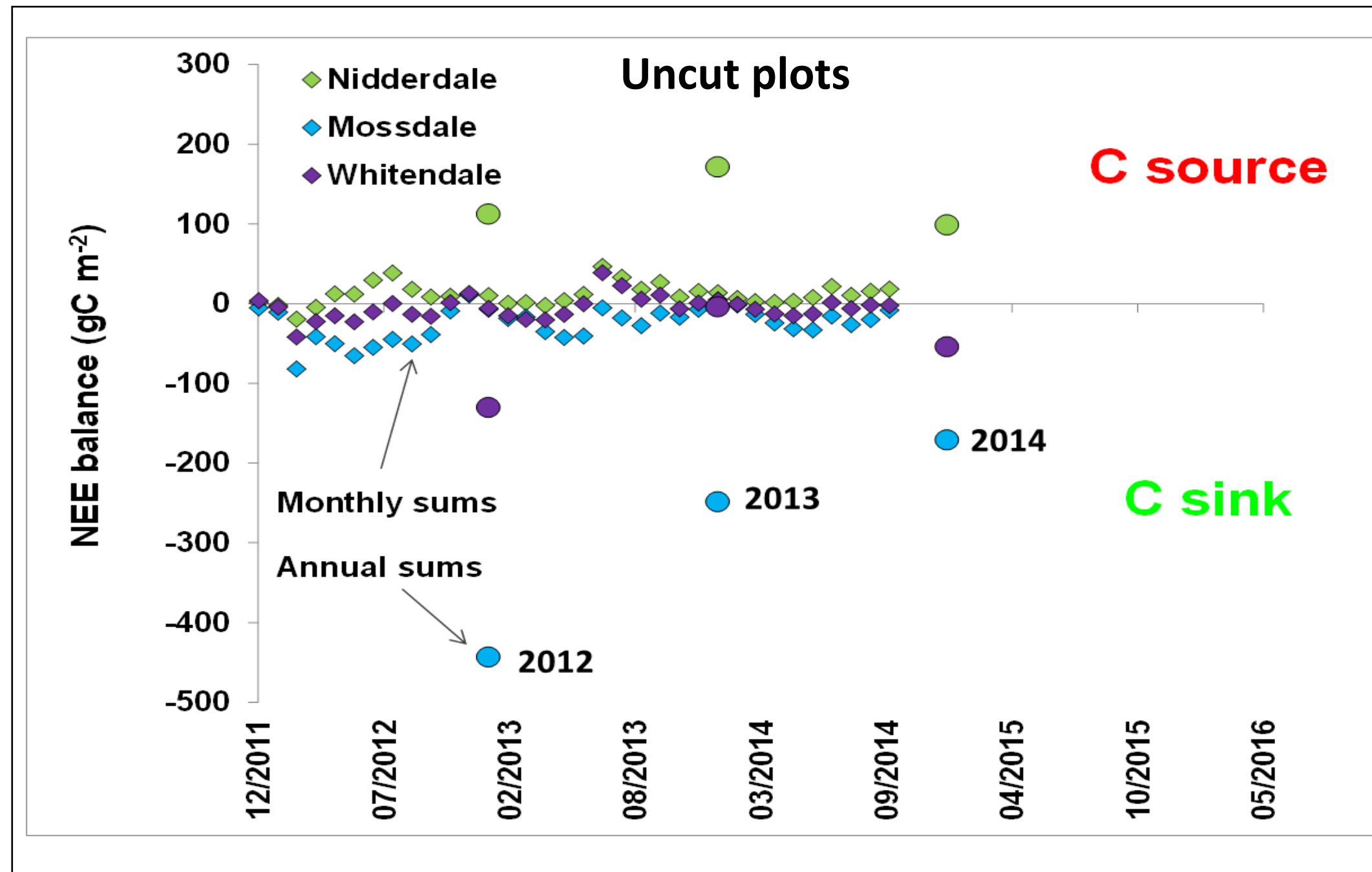
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Carbon fluxes

Modelled monthly carbon balance using chamber fluxes (NEE) indicated persistent interannual site differences with carbon uptake on uncut plots declining in the order: Mossdale > Whitendale > Nidderdale, which was in agreement with habitat status.

Carbon balance for managed plots revealed persistent losses from burnt plots whereas mown plots tended to recover from a net carbon source to a net carbon sink over a 2 year post-burn period.



Carbon budgets

Overall, sites showed a similar annual carbon loss in streams with DOC being around 10 times greater than POC export on a per area basis.

Cumulative site carbon budgets over two years post-management varied greatly between sites and with notably treatment differences. Burnt plots (+burnt C) lost just under 1 kg C m⁻².

Global warming potentials (GWP) including methane and N₂O emissions differed considerably between sites and range from intact (Mossdale) to degraded (Nidderdale).

	Burnt	Mown	Burnt	Mown	Annual estimate 2013		
					C POC (g m ⁻²)	C DOC (g m ⁻²)	
Nid	3.1	1.7	14.1	14.9	Nid	2.4	14.5
Moss	1.0	1.0	21.5	20.6	Moss	1.0	21.1
Whit	1.1	5.0	13.1	10.3	Whit	3.1	11.7

	Burnt	Mown	Burnt	Mown	Annual estimate 2014		
					C POC (g m ⁻²)	C DOC (g m ⁻²)	
Nid	1.9	0.9	12.3	15.5	Nid	1.4	13.9
Moss	0.3	0.5	14.0	15.7	Moss	0.4	14.9
Whit	0.6	1.9	13.6	16.8	Whit	1.2	15.2

2013-14 (C vs T)	Cumulative C balance (gC m ⁻²)		
	Nidd	Moss	Whit
Uncut	271	-419	-58
Mown	261	5	259
Burnt	311	312	417
Burnt C loss	661	662	767

2012-14 (Uncut)	Average CO ₂ balance and GWP p.a.		
	Nid	Moss	Whit
CO ₂ -gC	128	-287	-63
CO ₂ -g	468	-1054	-230
CH ₄ g (x25 for CO ₂ eq)	1.30	13.00	5.00
N ₂ O g (x298 for CO ₂ eq)	0.04	0.04	0.04
GWP tCO₂eq per km⁻² yr⁻¹	511	-719	-94

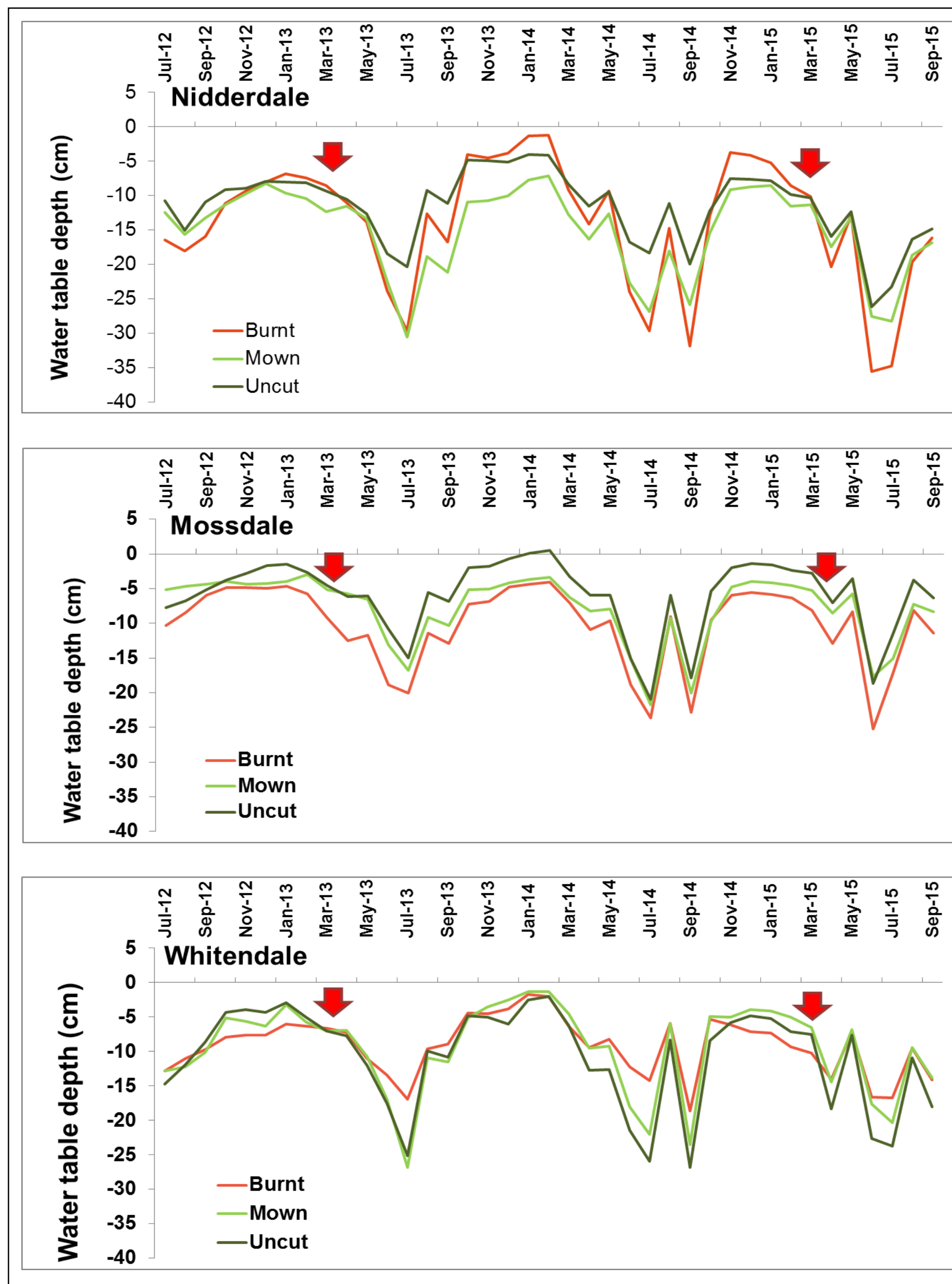
Hydrology

Mean monthly water tables showed similar seasonal patterns and declined overall in the order Mossdale > Whitendale > Nidderdale, reflecting habitat status (ie. intact to degraded).

Overall pre-periods showed similar water tables between treatments. Post-management periods (↓) revealed increasing separation of water tables, with a tendency of lower water tables in burnt plots for only two sites (Nidderdale and Mossdale).

The observed water table drop in the two catchments (Nidd and Moss) could be linked to the calculated loss of water leaving the catchment as a proportion of incoming rainfall.

Whereas pre-periods showed very similar proportions, increasing in winter and decreasing in summer, post-periods showed increased frequencies of higher proportional losses under burning. The differences were particularly high in winter. However, Whitendale did not show any clear management impact.



Flow/Rain (%)	Year	2012		2013		2014		2015	
		Month	% loss C	% loss T	% loss C	% loss T	% loss C	% loss T	% loss C
Nidderdale	1			101	103	80	64	81	64
	2			133	149	86	74	78	56
	3			103	106	61	50	81	56
	4			56	72	44	33	31	23
	5			42	47	66	45	48	37
	6			3	6	14	13	43	34
	7	119	126	18	14	11	9	16	11
	8	46	49	50	34	20	16	41	32
	9	60	60	31	23	14	9	20	16
	10	69	72	69	50	65	48	59	45
	11	82	86	71	54	73	54	80	62
	12	81	80	64	52	70	54	83	65
Mossdale	1			101	86	85	69	103	75
	2			102	91	87	71	84	64
	3			70	69	64	52	75	60
	4			54	55	48	37	53	39
	5			49	43	52	39	61	45
	6			19	14	29	20	47	35
	7	87	65	39	25	2	1	31	25
	8	47	52	69	43	39	29	62	48
	9	59	58	52	37	8	3	31	18
	10	64	67	80	60	65	48	63	49
	11	71	68	86	64	76	53	91	70
	12	85	76	86	65	79	59	100	75
Whitendale	1			150	155	60	63	84	89
	2			106	111	67	67	67	65
	3			43	43	55	55	64	64
	4			49	49	46	49	45	45
	5			46	48	41	40	54	51
	6			31	35	28	33	42	60
	7	78	86	35	35	8	11	27	26
	8	48	40	48	56	47	56	35	37
	9	68	64	51	52	34	45	32	35
	10	76	75	56	61	51	54	51	37
	11	73	72	69	86	55	55	82	87
	12	80	79	64	62	93	99	74	80

Water quality

Monthly water quality assessment in stream water revealed considerable variation over time and with clear differences between sites. However, pre-management ranges were very similar in the two catchments for all observed variables (i.e. pH, conductivity, Hazen, E4/E6, DOC, POC).

Management did not result in any clearly observed changes in any of the variables. However, DOC tended to be increased in stream flow from mown catchments, particularly during warmer (summer and autumn) periods.

Elemental analysis is still pending (e.g. for metals such as Pb, Fe).

