

Supplementary materials: Evaluation of spectral indices for assessing fire severity in Australian temperate forests

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Table S1. Numbers of reference plots for fire severity analysis by forest type

Forest type	Total area within fire boundary	Number of plots by wildfire severity class*				Total plots by forest type
		Unburnt	Low	Moderate	High	
Grassy / heathy Dry Forest	59,822	37	32	238	162	469
Tall Mixed Forest	1,515	21	21	25	26	93
Foothills Forest	9,401	22	27	48	30	127
Forby Forest	95,934	60	34	205	96	395
Moist Forest (S)	36,309	29	28	40	52	149
Moist Forest (R)	106,084	41	72	448	126	687
Riparian (higher rainfall)	12,127	24	24	26	34	108
Tall Mist Forest	69,828	68	27	64	25	184
Closed-forest	8,243	22	24	23	27	96
high Altitude Shrubland / Woodland	22,899	30	23	110	158	321
Inland Plains Woodland	10,116	25	23	33	27	108
Riverine Woodland / Forest	28,788	60	132	459	211	862
lowan Mallee	5,220	31	27	27	29	114
Broombush Whipstick	2,557	30	28	29	26	113
Total plots by fire severity		500	522	1775	1029	3826

* Fire severity classification was adopted from Department of Environment, Water, Land and Planning of Victoria (DEWLP), Melbourne, Victoria. Unburnt: no crown scorch severity with less than 1% of eucalypt and non-eucalypt crowns are scorched; Low severity: light crown scorch with 1 - 35% of eucalypt crowns are scorched; Moderate severity: moderate crown scorch with 30 - 65% of eucalypt crowns are scorched; High severity: crown burn with 70 - 100% of eucalypt crowns are burnt.

Table S2. Landsat 5 TM images used to compute spectral indices of the reference plots (bands used: 3÷7)

Fire season	Path	Row	Fire start date	Days before the fire	Days after the fire
1998	091	86	10 Jan 1998	48	32
2006	092	86	24 Feb 2006	96	80
2006	093	86	16 Feb 2006	17	64
2006	094	86	07 Feb 2006	16	32
2007	095	85	29 Nov 2006	48	48
2007	095	86	21 Nov 2006	40	56
2009	091	86	16 Feb 2009	23	41
2009	092	86	16 Feb 2009	16	64



Table S3. A summary of scores for all ten spectral indices from three methods of evaluation by forest type. Higher values in all cases indicates greater capacity to discriminate between fire-severity classes (i.e. a total score of 3 indicates strong discrimination by all three evaluation methods).

Forest name	Forest Group	Evaluation Methods	Scores by index									
			dND VI	dNB R	dND WI	dNB RT	dND VIT	dVI6 T	dba I	dMS AVI	dMI RBI	dCSI
Grassy / heathy Dry Forest	OF-R	ANOVA	0.75	1	1	1	1	1	0	0.75	0	1
		M analysis	0	1	0.75	1	0.75	0	0	0	0	0
		Optimality analysis	0	0.75	0.75	0.75	0	0	0	0	0	0.75
		Total	0.75	2.75	2.5	2.75	1.75	1	0	0.75	0	1.75
Tall Mixed Forest	OF-R	ANOVA	0.75	0.75	0.75	0	0.75	0.75	0	0.75	0	0
		M analysis	0	0	0	0	0	0	0	0	0	0
		Optimality analysis	0	0	0	0	0	0	0	0	0	0
		Total	0.75	0.75	0.75	0	0.75	0.75	0	0.75	0	0
Foothills Forest	OF-R	ANOVA	1	1	1	1	1	1	0.75	1	0.75	1
		M analysis	0	0.75	0.75	0.75	0.75	0.75	0	0	0	0
		Optimality analysis	0	0.75	0.75	0.75	0	0.75	0	0	0	0.75
		Total	1	2.5	2.5	2.5	1.75	2.5	0.75	1	0.75	1.75
Forby Forest	OF-R	ANOVA	0.75	0.75	1	0.75	0.75	0.75	0	0.75	0	0.75
		M analysis	0.75	1	1	0.75	0	0.75	0	0.75	0	0
		Optimality analysis	0	0.75	0	0	0	0	0	0	0	0
		Total	1.5	2.5	2	1.5	0.75	1.5	0	1.5	0	0.75
Moist Forest	OF-R	ANOVA	0.75	0.75	1	0.75	0.75	0.75	0.75	0.75	1	1
		M analysis	0	1	0.75	0.75	0	0.75	0	0	0.75	0
		Optimality analysis	0	0.75	0	0	0	0	0	0	0	0
		Total	0.75	2.5	1.75	1.5	0.75	1.5	0.75	0.75	1.75	1
Moist Forest	CF-S	ANOVA	1	0.75	0.75	0.75	1	1	0.75	1	0	0
		M analysis	1	1	1	1	1	1	1	1	0	0.75
		Optimality analysis	0	0.75	1	0.75	0	0	0	0	0	1
		Total	2	2.5	2.75	2.5	2	2	1.75	2	0	1.75
Riparian (higher rainfall)	OF-RS	ANOVA	0.75	0	0	0	0.75	0.75	0	0.75	0	0
		M analysis	1	0.75	0	1	0.75	0	0	0.75	0	0
		Optimality analysis	0	0	0.75	0	0	0	0	0	0	0.75
		Total	1.75	0.75	0.75	1	1.5	0.75	0	1.5	0	0.75
Tall Mist Forest	CF-S	ANOVA	0	0	0.75	0.75	0	0.75	0.75	0.75	0	0
		M analysis	0.75	0	0.75	0	0	0	0	0.75	0	0.75
		Optimality analysis	0	0	0	0	0	0	0	0	0	0
		Total	0.75	0	1.5	0.75	0	0.75	0.75	1.5	0	0.75
Closed-forest	CF-R	ANOVA	0	0	0	0	0	0	0	0	0	0
		M analysis	0	0	0	0	0	0	0	0	0	0
		Optimality analysis	0	0	0	0	0	0	0	0	0	0
		Total	0	0	0	0	0	0	0	0	0	0

high Altitude Shrubland / Woodland	W-R	ANOVA	1	1	1	1	1	1	0	1	0	1
		M analysis	0.75	1	0.75	1	0.75	0.75	0.75	0.75	0	0
		Optimality analysis	0	1	1	0	0	0.75	0	0	0	1
		Total	1.75	3	2.75	2	1.75	2.5	0.75	1.75	0	2
Inland Plains Woodland	W-R	ANOVA	0.75	0.75	0.75	0.75	0.75	0.75	0	0.75	0.75	0.75
		M analysis	0.75	0	0	0	0.75	0	0	0.75	0	0
		Optimality analysis	0	0	0	0	0	0	0	0	0	0
		Total	1.5	0.75	0.75	0.75	1.5	0.75	0	1.5	0.75	0.75
Riverine Woodland / Forest	W-R	ANOVA	1	1	1	1	1	0.75	0	1	1	1
		M analysis	0	0.75	0	0.75	0	0	0	0	0	0
		Optimality analysis	0	0.75	0.75	0	0	0	0	0	0	0.75
		Total	1	2.5	1.75	1.75	1	0.75	0	1	1	1.75
lowan Mallee	LW-R	ANOVA	0.75	0.75	0	0.75	0.75	0	0	0.75	0.75	0
		M analysis	0	0	0	0	0.75	0	0	0	0.75	0
		Optimality analysis	0	0	0	0	0	0	0	0	0	0
		Total	0.75	0.75	0	0.75	1.5	0	0	0.75	1.5	0
Broombush Whipstick	LW-R	ANOVA	0	1	0.75	1	0	0	0	0	1	0.75
		M analysis	0	0	0	0.75	0	0	0	0	0	0
		Optimality analysis	0	0	0	0	0	0	0	0	0	0
		Total	0	1	0.75	1.75	0	0	0	0	1	0.75

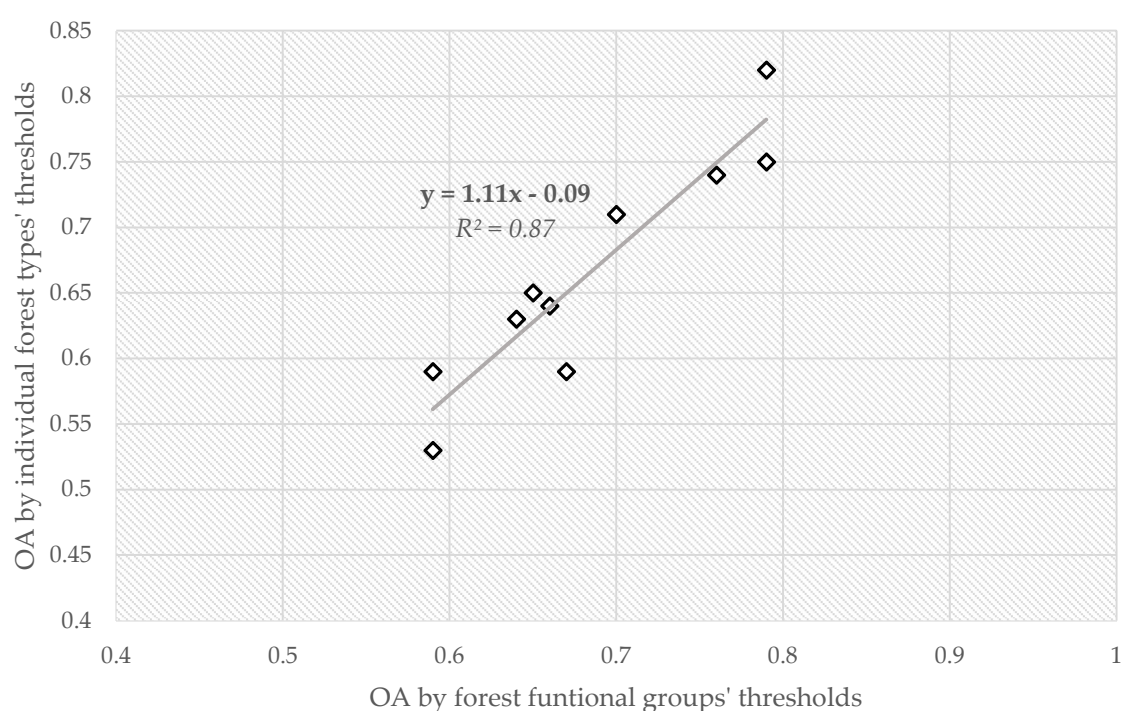
Table S4. Thresholds for selected spectral indices for fire severity assessment by forest groups or type

Forest group	Spectral index	Thresholds*		
		U to L	L to M	M to H
OF-R	dNBR	0.040	0.215	0.545
OF-R	dNDWI	0.033	0.185	0.395
W-R	dNBR	0.083	0.260	0.540
W-R	dNDWI	0.050	0.190	0.375
W-R (Inland Plains Woodland)	dNDVI	-0.050	0.035	0.263
W-R (Inland Plains Woodland)	dNDVIT	-0.020	0.065	0.305
W-R (Inland Plains Woodland)	dMSAVI	-0.070	0.045	0.310
LW-R	dNBR	0.063	0.160	0.360
LW-R	dNBRT	0.100	0.225	0.475
OF-RS	dNDVI	-0.098	0.160	0.340
OF-RS	dNDVIT	-0.055	0.128	0.320
OF-RS	dMSAVI	-0.080	0.158	0.358
CF-S	dNDWI	-0.003	0.203	0.438
OF-R + W-R	dNBR	0.050	0.230	0.550
OF-R + W-R	dNDWI	0.035	0.180	0.385
OF-RS + W-R (Inland Plains Woodland)	dNDVI	-0.073	0.128	0.328
OF-RS + W-R (Inland Plains Woodland)	dNDVIT	-0.043	0.128	0.330
OF-RS + W-R (Inland Plains Woodland)	dMSAVI	-0.075	0.125	0.333

* U, L, M and H stand for unburnt, low, moderate and high severity classes; values indicate the index value at the transition between two fire-severity classes (e.g. values below the 'U to L' threshold are classified as Unburnt, and those above are classified as Low-severity up to the L to M threshold etc).

Table S5. Thresholds by forest type for selected spectral indices of the transition from Unburnt and Low (UL) to Moderate and High (MH) fire severity.

Forest group	Spectral indices	Thresholds*
OF-R	dNBR	0.230
OF-R	dNDWI	0.190
W-R	dNBR	0.273
W-R	dNDWI	0.203
W-R (Inland Plains Woodland)	dNDVI	0.125
W-R (Inland Plains Woodland)	dNDVIT	0.160
W-R (Inland Plains Woodland)	dMSAVI	0.140
LW-R	dNBR	0.218
LW-R	dNBRT	0.300
OF-RS	dNDVI	0.153
OF-RS	dNDVIT	0.108
OF-RS	dMSAVI	0.150
CF-S	dNDWI	0.230

**Figure S1.** Scatterplot between overall accuracies (OA) estimated using defined thresholds in the best-performing index by forest type (i.e. mean of multiple forest types per group) and by forest functional group types per group, indicating similar levels of accuracy at the two levels of forest classification. Each point represents for each best performing index in each forest type.

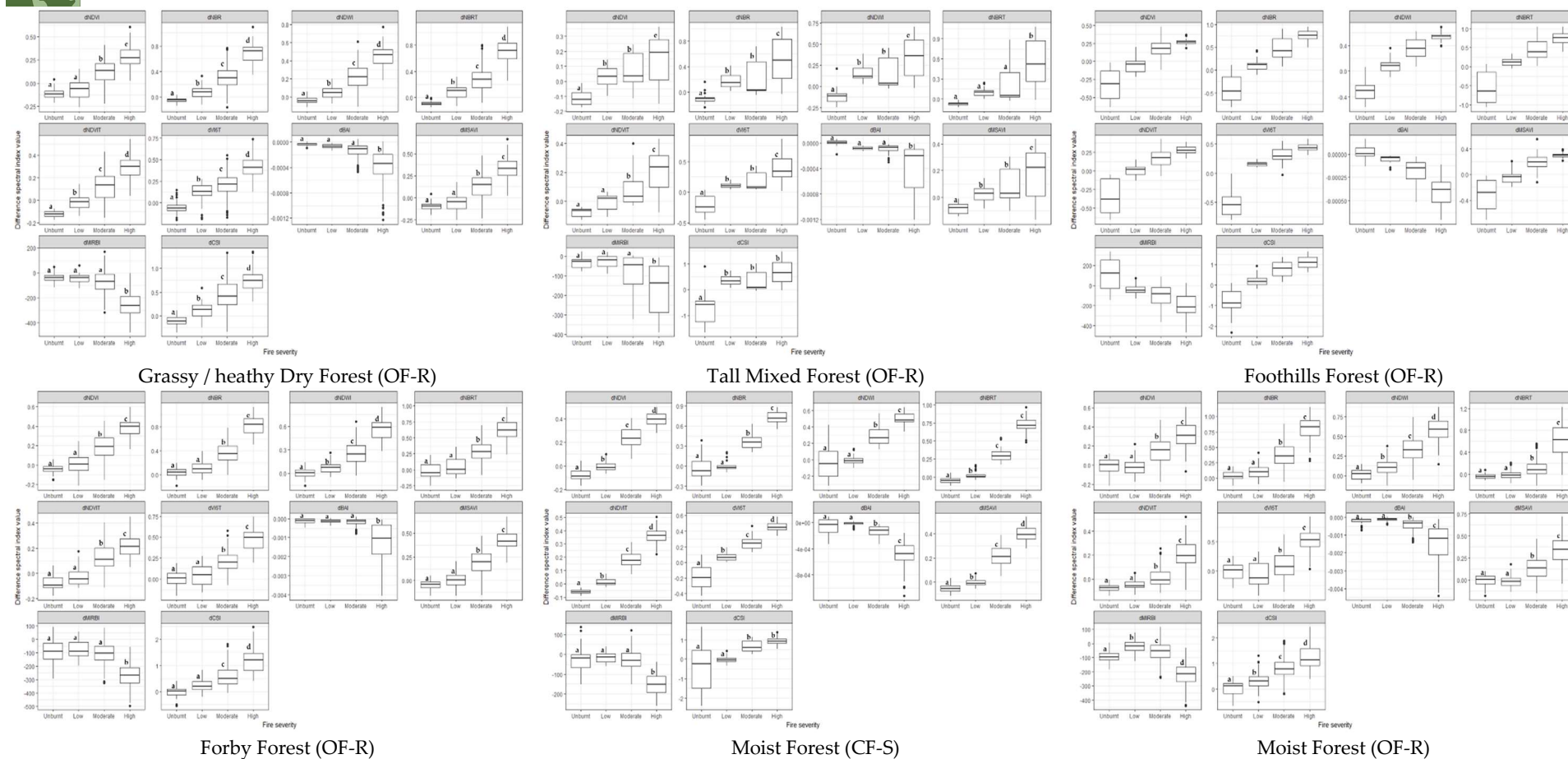


Figure S2. Boxplots of 10 difference indices between pre- and post-fire spectral indices derived from Landsat satellite images at four different fire severity classes (unburnt, low, moderate and high severity) for all individual forest types. (Means that do not share a letter are statistically significant different).

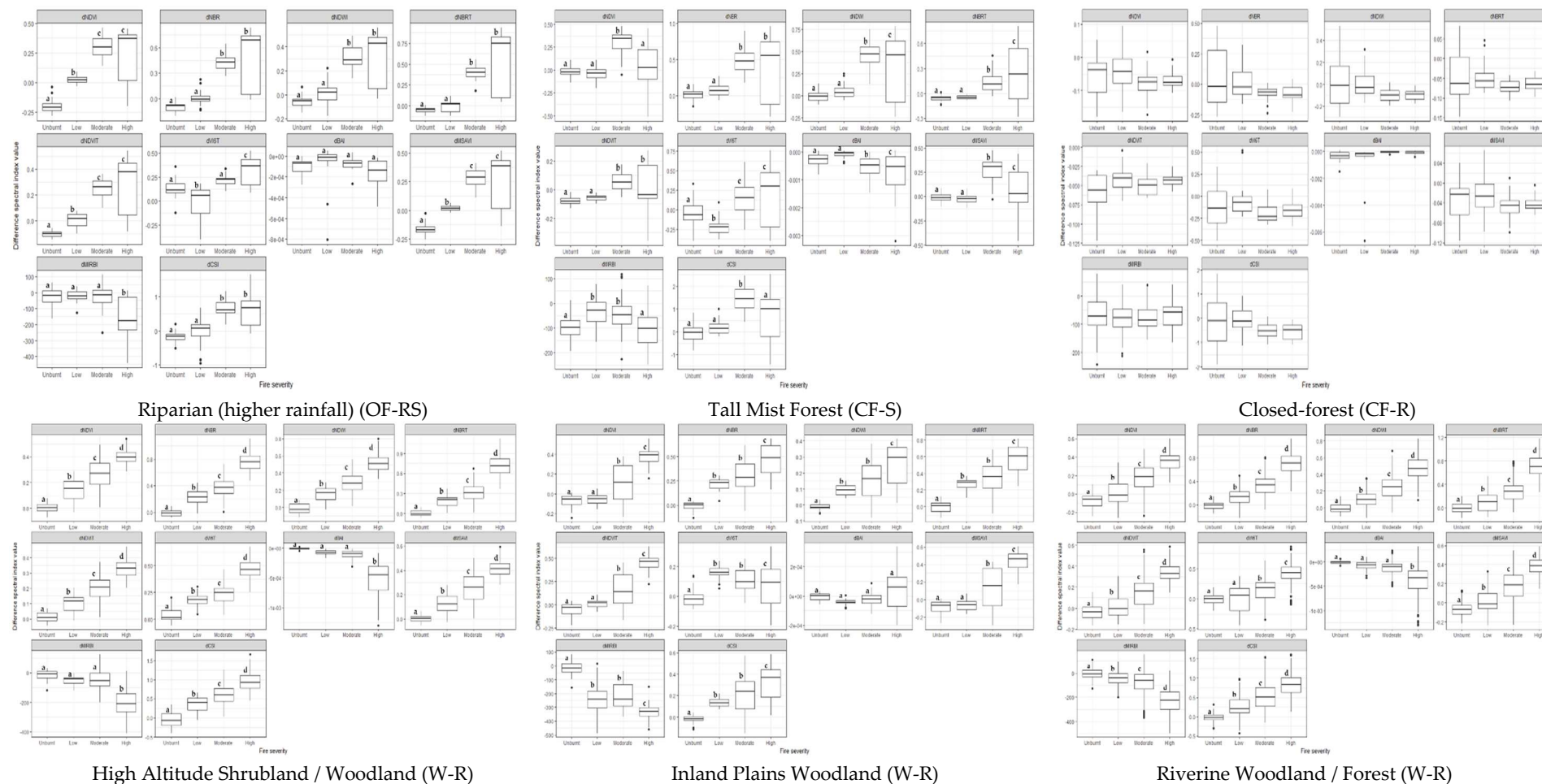


Figure S2. (Continued) Boxplots of 10 difference indices between pre- and post-fire spectral indices derived from Landsat satellite images at four different fire severity classes (unburnt, low, moderate and high severity) for all individual forest types. (Means that do not share a letter are statistically significant different).

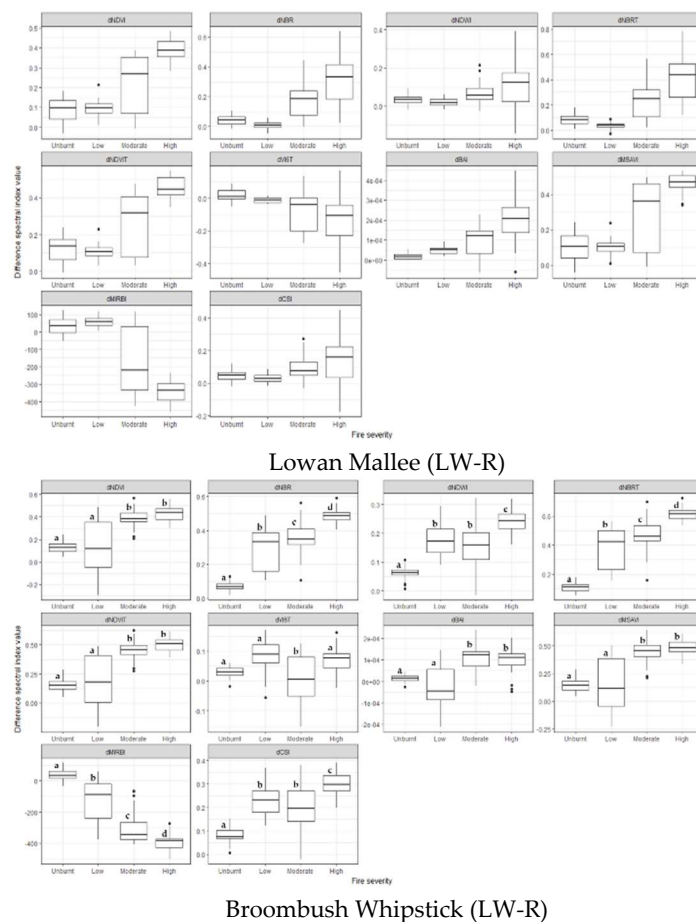


Figure S2. (Continued) Boxplots of 10 difference indices between pre- and post-fire spectral indices derived from Landsat satellite images at four different fire severity classes (unburnt, low, moderate and high severity) for all individual forest types. (Means that do not share a letter are statistically significant different).

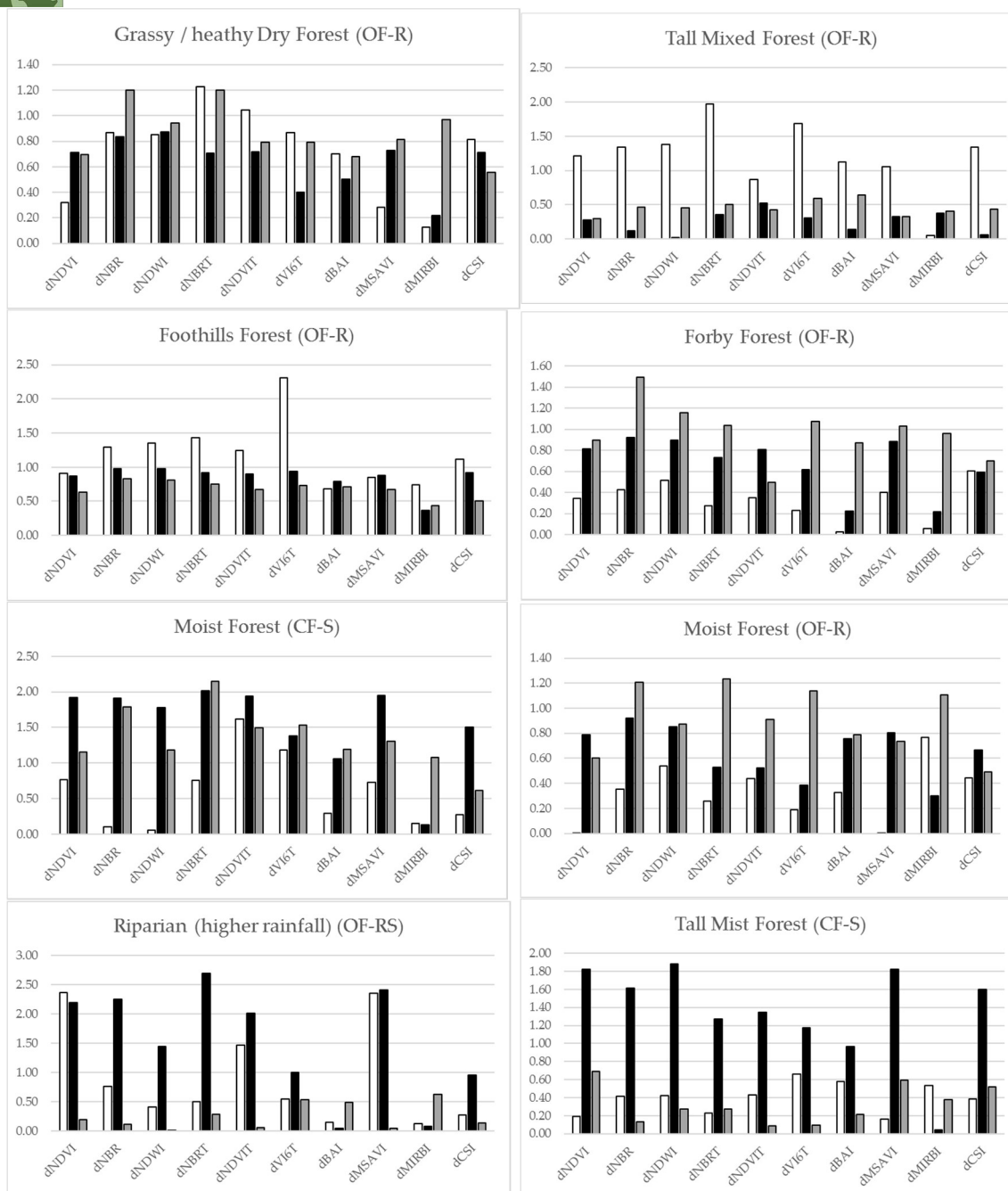


Figure S3. M values indicating the capacity of 10 spectral indices to distinguish between fire-severity classes for resprouter (R), obligate seeder (S) and mixed traits (RS) forest types; the higher the value of M, the better the discrimination between two classes.

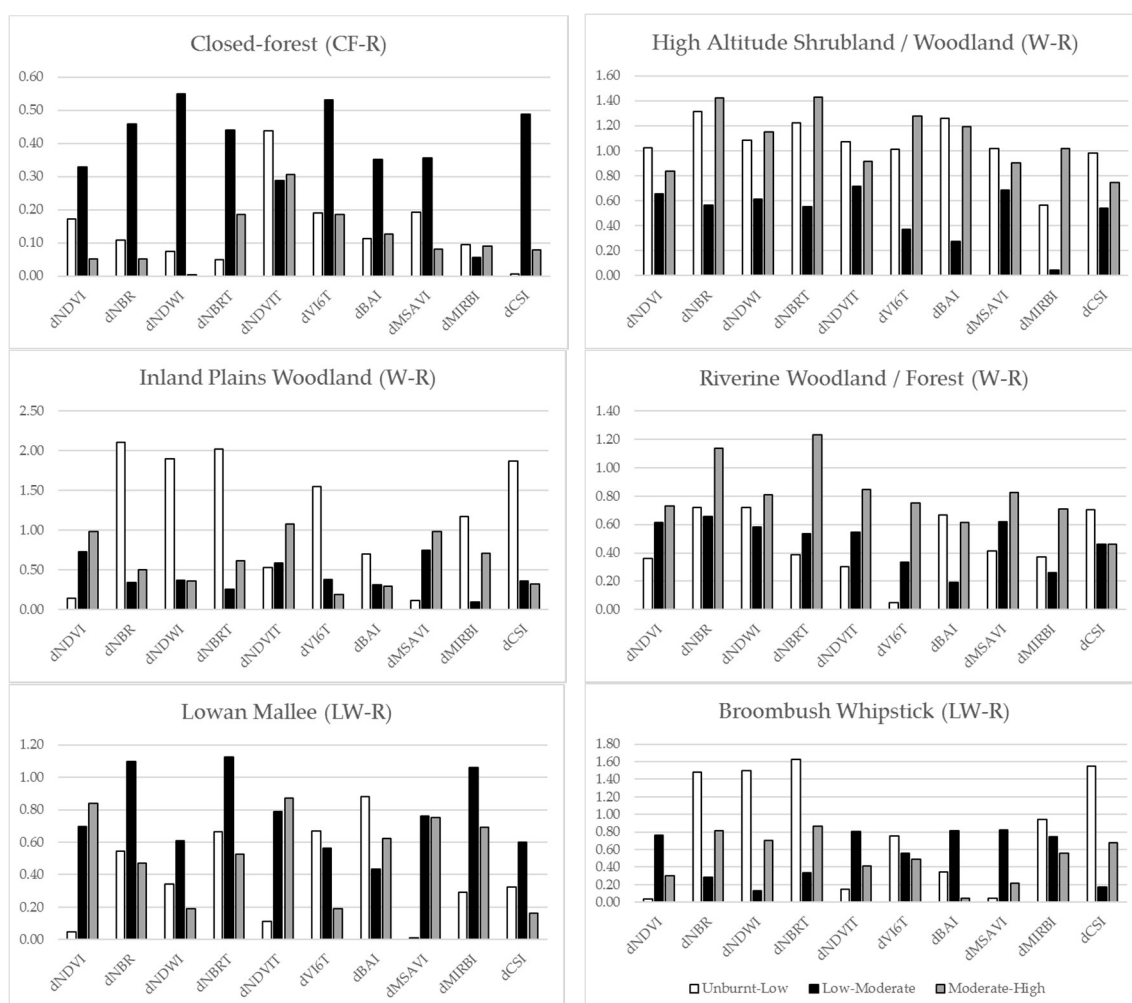


Figure S3. (Continued) M values indicating the capacity of 10 spectral indices to distinguish between fire-severity classes for resprouter (R), obligate seeder (S) and mixed traits (RS) forest types; the higher the value of M, the better the discrimination between two classes.

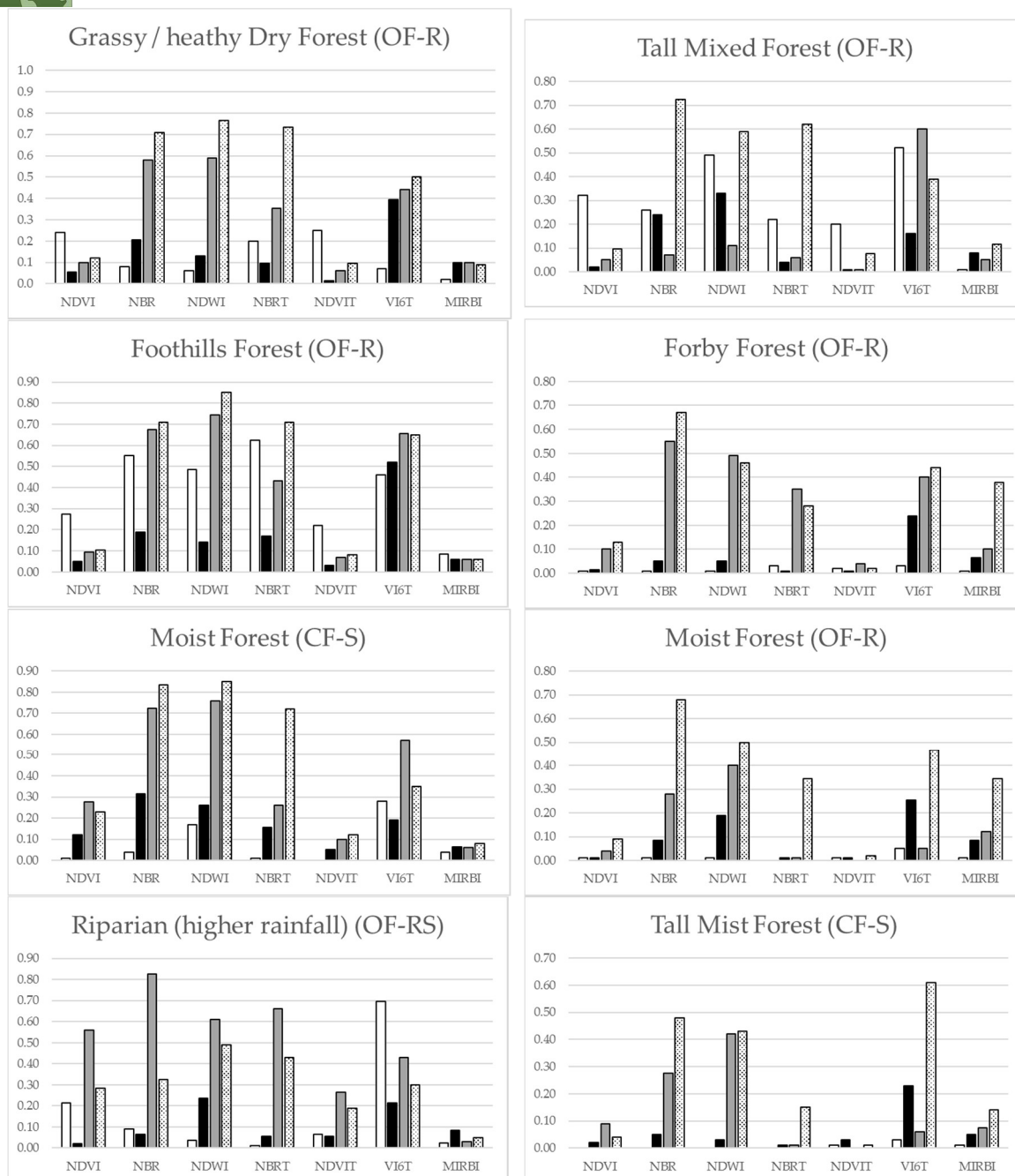


Figure S4. Bar charts for median values of spectral indices' optimality derived from Landsat satellite images at four different classes: unburnt to low, moderate and high severity) for the resprouter (R), obligate seeder (S) and mixed traits (RS) forest ecosystems. Optimality values for NDVI, BAI and MSAVI are equal; Optimality values for NDWI and CSI are also equal due to the same input bands for calculating these optimality values.

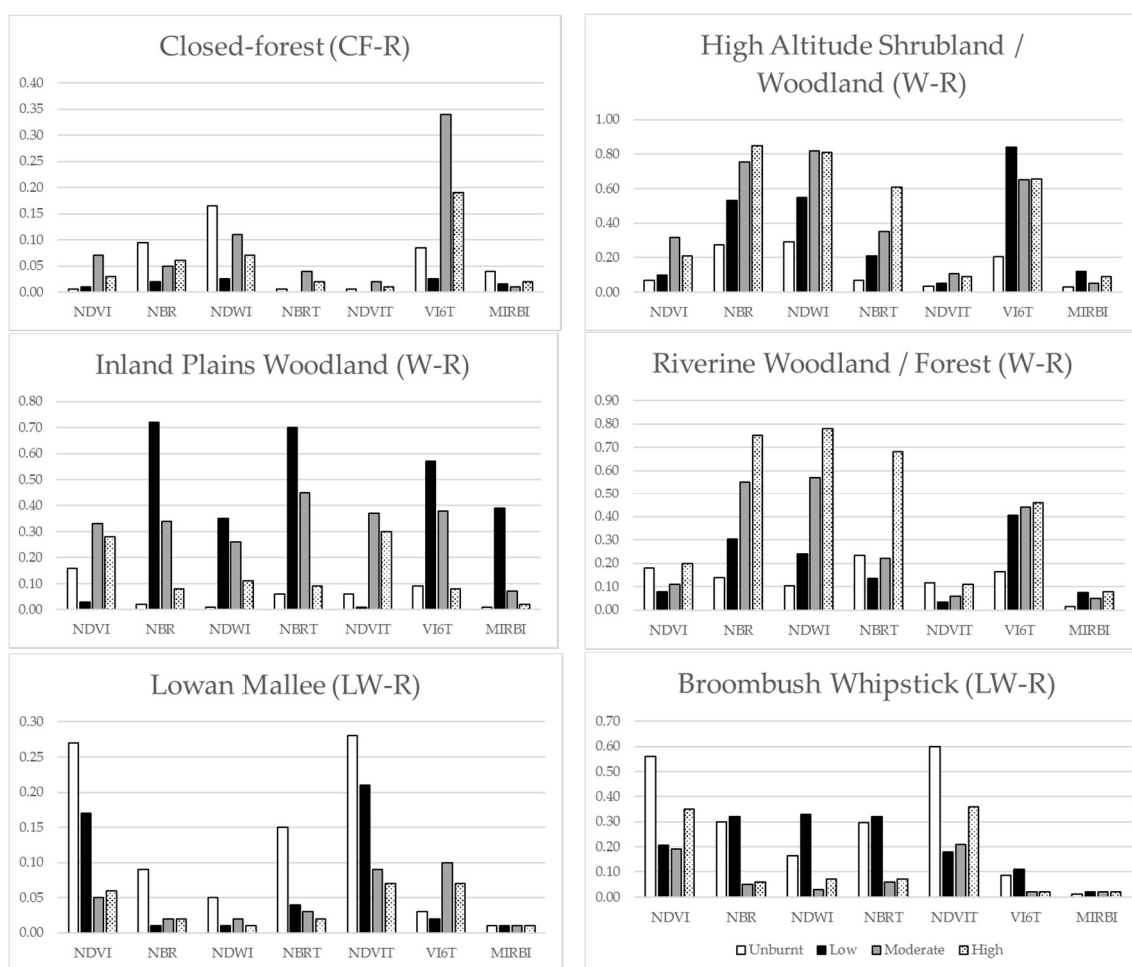


Figure S4. (Continued) Bar charts for median values of spectral indices' optimality derived from Landsat satellite images at four different classes: unburnt to low, moderate and high severity) for the resprouter (R), obligate seeder (S) and mixed traits (RS) forest ecosystems. Optimality values for NDVI, BAI and MSAVI are equal; Optimality values for NDWI and CSI are also equal due to the same input bands for calculating these optimality values.



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