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Supplementary Material

An exploratory analysis of forest fine fuel consumption and accumulation using forest inventory data and fire history

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Table S1. Published pre-fire and consumption values of fine fuel loads (FFL) from peer-reviewed studies in southeastern Australian forests, grouped according to fuel layer and burn severity. Burn severity levels were defined based on descriptions in the reviewed studies. (VIC = Victoria; NSW = New South Wales; ACT = Australian Capital Territory; PB = prescribed burn; WF = wildfire; s.e. = standard error; *E.* = *Eucalyptus*).

Reference	Forest type, location (dominated species)	Study sites/cases	Sample size	Fire type	Burn severity	Pre-fire & s.e. (t/ha)	Loss & s.e. (t/ha)	Loss %
Canopy FFL								
Volkova *et al.* (2014)	Dry shrubby Eucalyptus forests, Central Highlands, VIC (*E. Muelleriana*)	-	5	PB	Low	3.83 (0.85)	0.00	0.0
Possell *et al.* (2015)	Lowland forests - Orbost, East Gippsland, VIC (*E.muelleriana, E. globoidea, E. consideniana*)	Oliver	3	PB	Low	14.87 (4.32)	2.79	18.8
		Pettmans	3	PB	Low	3.73 (1.4)	0.35	9.40
		South Boundary	3	PB	Low	2.78 (1.41)	0.66	23.7
		Upper Tambo	3	PB	Low	6.07 (1.95)	1.18	19.4
Price *et al*. (2022)	Dry sclerophyll forests, NSW	Severity =1	44	PB+WF	Low	4.48 (0.26)	0.90	20.0
		Severity =2	44	PB+WF	Low	4.48 (0.26)	0.00	0.0
		Severity =3	44	PB+WF	Medium	4.48 (0.26)	0.67	15.0
		Severity =4	44	PB+WF	Medium	4.48 (0.26)	1.12	25.0
Volkova *et al.* (2014)	Dry shrubby Eucalyptus forests, southeast VIC (*E. Muelleriana*)	-	3	WF	High	3.83 (0.85)	3.83 (0.85)	100.0
Price *et al*. (2022)	Dry sclerophyll forests, NSW	Severity =5	44	WF	High	4.48 (0.26)	3.36	75.0
Elevated FFL								
Raison *et al.* (1985)	Sub-alpine eucalypt forests, ACT (*E. pauciflora E. dives, E. delegatensis*)	*E. pauciflora*	10	PB	Low	5.4 (0.3)	3.9 (0.30)	72.2
		E. dives	10	PB	Low	6.1 (0.5)	3.5 (0.30)	57.4
		E.delegatensis	10	PB	low	4.5 (0.3)	2.4 (0.20)	53.3
Possell *et al.* (2015)	Lowland forests - Orbost, East Gippsland, VIC (*E.muelleriana, E. globoidea, E. consideniana*)	Oliver	3	PB	Low	1.78 (1.5)	0.09	5.1
		Pettmans	3	PB	Low	0.8 (0.54)	0.04	5.0
		South Boundary	3	PB	Low	1.01 (0.37)	0.49	48.5
		Upper Tambo	3	PB	Low	0.29 (0.17)	0.19	65.5
Price *et al*. (2022)	Dry sclerophyll forests, NSW	Severity =1	44	PB+WF	Low	1.34 (0.15)	0.80	60.0
		Severity =2	44	PB+WF	Low	1.34 (0.15)	0.47	35.0

Reference	Forest type, location (dominated species)	Study sites/cases	Sample size	Fire type	Burn severity	Pre-fire & s.e. (t/ha)	Loss & s.e. (t/ha)	Loss %
Nolan *et al.* (2022)	Dry sclerophyll forests, NSW	shrubs	54	PB	Medium	1.09	0.35	32.1
Price *et al*. (2022)	Dry sclerophyll forests, NSW	Severity =3	44	PB+WF	Medium	1.34 (0.15)	0.54	40.0
		Severity =4	44	PB+WF	Medium	1.34 (0.15)	1.01	75.0
Murphy *et al.* (2019)	Various	Various	38	WF	High	2.50	2.00	80.0
Price *et al*. (2022)	Dry sclerophyll forests - NSW	Severity =5	44	PB+WF	High	1.34 (0.15)	1.01	75.0
Near-surface FFL								
Volkova and Weston (2013)	Eucalypt forests in Otway Ranges, VIC (*E. obliqua*)	-	9	PB	Low	3 (0.4)	2.98 (0.43)	99.3
Volkova *et al.* (2014)	Dry shrubby Eucalyptus forests, Central Highlands, VIC (*E. Muelleriana*)	-	5	PB	Low	5.74 (0.64)	1.91 (1.28)	33.3
Volkova and Weston (2015)	Dry Eucalyptus forests, southeastern Australia (*E. obliqua, E. sieberi, E. muelleriana, E. rossii, E. polyanthemos*)	Foothill -VIC	16	PB	Low	7.94 (1.67)	3.42	43.1
		Shrubby -VIC	5	PB	Low	12.09 (3.34)	2.77	22.9
		Woodland -SA	5	PB	Low	5.88 (1.96)	1.78	30.2
		Grassy - ACT	5	PB	Low	8.26 (1.18)	2.85	34.5
Possell *et al.* (2015)	Lowland forests - Orbost, East Gippsland, VIC (*E.muelleriana, E. globoidea, E. consideniana*)	Oliver	3	PB	Low	3.31 (1.57)	3.29	99.4
		Pettmans	3	PB	Low	0.62 (0.33)	0.62 (0.33)	100.0
		South Boundary	3	PB	Low	0.33 (0.18)	0.33 (0.18)	100.0
		Upper Tambo	3	PB	Low	0.11 (0.06)	0.11 (0.06)	100.0
Price *et al*. (2022)	Dry sclerophyll forests, NSW	Severity =1	44	PB+WF	Low	2.33 (0.2)	1.86	80.0
		Severity =2	44	PB+WF	Low	2.33 (0.2)	2.10	90.0
Volkova *et al.* (2014)	Dry shrubby Eucalyptus forests, Central Highlands, VIC (*E. Muelleriana*)	E. Muelleriana	5	WF	Medium	5.74 (0.64)	3.19 (0.64)	55.6
Price *et al*. (2022)	Dry sclerophyll forests , NSW	Severity =3	44	PB+WF	Medium	2.33 (0.2)	1.98	85.0
		Severity =4	44	PB+WF	Medium	2.33 (0.2)	2.33	100.0
Volkova *et al.* (2014)	Dry shrubby Eucalyptus forests, Central Highlands, VIC (*E. Muelleriana*)	E. Muelleriana	3	WF	High	5.74 (0.64)	5.74 (0.64)	100.0
Murphy *et al.* (2019)	Various	Various	38	WF	High	2.00	2.00	100.0
Price *et al*. (2022)	Dry sclerophyll forests, NSW	Severity =5	44	PB+WF	High	2.33 (0.2)	2.33	100.0
Surface FFL								
Raison *et al.* (1985)	Sub-alpine eucalypt forests, ACT (*E. pauciflora E. dives, E. delegatensis*)	*E. pauciflora*	10	PB	Low	16.1 (1.2)	7.5 (1.50)	46.6
		E. dives	10	PB	Low	16.6 (1.2)	8.5 (1.60)	51.2

Reference	Forest type, location (dominated species)	Study sites/cases	Sample size	Fire type	Burn severity	Pre-fire & s.e. (t/ha)	Loss & s.e. (t/ha)	Loss %
		E. delegatensis	10	PB	Low	16.5 (1.2)	9.2 (1.80)	55.8
Hollis *et al.* (2011)	Various, southeast Australia	-	29	PB	Low	10.50	8.00	76.2
Volkova and Weston (2013)	Eucalypt forests in Otway Ranges, VIC (*E. obliqua*)	-	9	PB	Low	14.68	9.36 (1.40)	63.8
Volkova *et al.* (2014)	Dry shrubby Eucalyptus forests, Central Highlands, VIC (*E. Muelleriana*)	-	5	PB	Low	12.55 (2.55)	4.89 (3.19)	39.0
Volkova and Weston (2015)	Dry Eucalyptus forests, southeastern Australia (*E. obliqua, E. sieberi, E. muelleriana, E. rossii, E. polyanthemos*)	Foothill -VIC	16	PB	Low	13.51 (1.23)	9.17	67.9
		Shrubby -VIC	5	PB	Low	12.54 (4.51)	7.20	57.4
		Woodland -SA	5	PB	Low	17.43 (7.1)	8.72	50.1
		Grassy - ACT	5	PB	Low	14.07 (4.14)	6.99	49.7
Possell *et al.* (2015)	Lowland forests - Orbost, East Gippsland, VIC (*E.muelleriana, E. globoidea, E. consideniana*)	Oliver	3	PB	Low	12.71 (2.81)	5.73	45.1
		Pettmans	3	PB	Low	13.72 (2.96)	13.42	97.8
		South Boundary	3	PB	Low	16.46 (1.72)	15.97	97.0
		Upper Tambo	3	PB	Low	21.34 (12.29)	20.95	98.2
Jenkins *et al.* (2016)	Lowland open forest, East Gippsland, VIC (*E. muelleriana*)	-	9	PB	Low	15.86	13.8 (1.40)	87.0
Volkova and Weston (2019)	Eucalyptus sieberi dry forest, East Gippsland, VIC (*E. sieberi*)	-	20	PB	Low	5.26 (0.38)	2.55 (1.28)	48.6
Price *et al*. (2022)	Dry sclerophyll forests, NSW	Severity =1	44	PB+WF	Low	15.11 (0.79)	8.00	52.9
		Severity =2	44	PB+WF	Low	15.11 (0.79)	9.07	60.0
Volkova *et al.* (2014)	Dry shrubby Eucalyptus forests, Central Highlands, VIC (*E. Muelleriana*)	-	5	WF	Medium	12.55 (2.55)	6.6 (0.21)	52.5
Volkova and Weston (2019)	Eucalyptus sieberi dry forest, East Gippsland, VIC (*E. sieberi*)	-	20	PB	Medium	5.26 (0.38)	5.26 (0.43)	100.0
Price *et al*. (2022)	Dry sclerophyll forests – NSW	Severity =3	44	PB+WF	Medium	15.11 (0.79)	9.07	60.0
		Severity =4	44	PB+WF	Medium	15.11 (0.79)	11.33	75.0
Hollis *et al.* (2011)	Kilomore fire, VIC	-	4	WF	High	11.00	11.00	100.0
Volkova *et al.* (2014)	Dry shrubby Eucalyptus forests, Central Highlands, VIC (*E. Muelleriana*)	-	3	WF	High	12.55 (2.55)	12.55 (2.55)	100.0
Murphy *et al.* (2019)	Various	-	38	WF	High	8.00	7.00	87.5
Price *et al*. (2022)	Dry sclerophyll forests, NSW	Severity =5	44	PB+WF	High	15.11 (0.79)	12.84	85.0

Table S2. Mean of pre-fire, estimated consumption, and post-fire FFL (with standard errors, s.e., in brackets) for each fuel variable (t ha^{-1}), categorised by fire type and burn severity.

Fuel variable	Serverity	Wildfire (*n* = 121)			Prescribed burn (*n* = 52)		
		Pre-fire	Consumption	Post-fire	Pre-fire	Consumption	Post-fire
Canopy$_{FFL}$		4.92 (0.34)			4.25 (0.34)		
	Low		0.64 (0.09)	4.28 (0.58)		0.55 (0.04)	3.7 (0.28)
	Medium		0.98 (0.10)	3.93 (0.38)		0.85 (0.19)	3.4 (0.75)
	High		4.33 (0.43)	0.59 (0.06)		NA	NA
Elevated$_{FFL}$		1.43 (0.18)			1.01 (0.25)		
	Low		0.64 (0.11)	0.79 (0.13)		0.45 (0.13)	0.56 (0.16)
	Medium		0.70 (0.13)	0.73 (0.14)		0.5 (0.21)	0.52 (0.22)
	High		1.12 (0.30)	0.31 (0.08)			
Near-surface$_{FFL}$		2.87 (0.24)			2.70 (0.33)	a	a
	Low		1.98 (0.31)	0.89 (0.14)		1.87 (0.29)	0.84 (0.13)
	Medium		2.30 (0.24)	0.57 (0.06)		2.16 (0.42)	0.54 (0.10)
	High		2.87 (0.73)	0.00 (0.00)		NA	NA
Surface$_{FFL}$		13.37 (0.77)			11.68 (0.87)		
	Low		8.56 (0.79)	4.81 (0.45)		7.47 (0.72)	4.20 (0.40)
	Medium		9.62 (0.76)	3.74 (0.3)		8.41 (0.71)	3.27 (0.28)
	High		12.44 (2.04)	0.94 (0.15)		NA	NA
Total$_{FFL}$		21.73 (0.96)			18.01 (1.05)		
	Low		11.28 (0.84)	10.45 (0.86)		9.35 (0.81)	8.66 (0.57)
	Medium		13.16 (0.87)	8.57 (0.52)		10.78 (0.79)	7.23 (0.85)
	High		19.92 (2.42)	1.80 (0.20)		NA	NA

Table S3. Mean of pre-fire, estimated consumption, and post-fire FFL (with standard errors, s.e., in brackets) for each fuel variable (t ha^{-1}), categorised by forest cover and burn severity.

Fuel variable	Severity	**Closed forest (*n* = 65)**			**Open forest (*n* = 81)**			**Woodland (*n* = 27)**		
		Pre-fire	Consumption	Remaining	Pre-fire	Consumption	Remaining	Pre-fire	Consumption	Remaining
Canopy$_{FFL}$		5.36 (0.42)			4.34 (0.38)			3.74 (0.38)		
	Low		0.70 (0.08)	4.66 (0.54)		0.56 (0.07)	3.78 (0.49)		0.49 (0.05)	3.25 (0.32)
	Medium		1.07 (0.13)	4.28 (0.51)		0.87 (0.12)	3.47 (0.48)		0.75 (0.21)	3.00 (0.83)
	High		4.72 (0.58)	0.64 (0.08)		3.82 (0.35)	0.52 (0.05)		3.29 (1.06)	0.45 (0.14)
Elevated$_{FFL}$		1.81 (0.25)			0.86 (0.13)			0.92 (0.37)		
	Low		0.81 (0.17)	0.99 (0.21)		0.39 (0.09)	0.47 (0.11)		0.41 (0.05)	0.5 (0.06)
	Medium		0.89 (0.18)	0.92 (0.19)		0.42 (0.07)	0.44 (0.08)		0.45 (0.27)	0.47 (0.28)
	High		1.41 (0.47)	0.40 (0.13)		0.67 (0.17)	0.19 (0.05)		0.72 (0.11)	0.2 (0.03)
Near-surface$_{FFL}$		3.10 (0.29)			2.81 (0.30)			2.00 (0.55)		
	Low		2.14 (0.36)	0.96 (0.16)		1.94 (0.30)	0.87 (0.14)		1.38 (0.41)	0.62 (0.18)
	Medium		2.48 (0.31)	0.62 (0.08)		2.24 (0.31)	0.56 (0.08)		1.60 (0.58)	0.40 (0.15)
	High		3.10 (1.02)	0.00 (0.00)		2.81 (1.23)	0.00 (0.00)		1.99 (0.69)	0.00 (0.00)
Surface$_{FFL}$		15.41 (1.1)			11.58 (0.70)			9.36 (0.99)		
	Low		9.86 (1.30)	5.55 (0.73)		7.41 (0.67)	4.17 (0.38)		5.99 (0.65)	3.37 (0.36)
	Medium		11.09 (1.00)	4.31 (0.39)		8.34 (0.65)	3.24 (0.25)		6.74 (1.52)	2.62 (0.59)
	High		14.33 (3.63)	1.08 (0.27)		10.77 (0.75)	0.81 (0.06)		8.70 (2.43)	0.65 (0.18)
Total$_{FFL}$		24.14 (1.27)			18.84 (0.93)			14.9 (1.19)		
	Low		12.38 (1.37)	11.76 (1.04)		9.86 (0.75)	8.98 (0.74)		7.76 (0.75)	7.14 (0.40)
	Medium		14.57 (1.16)	9.57 (0.68)		11.33 (0.81)	7.51 (0.61)		9.37 (1.20)	5.53 (0.88)
	High		22.09 (3.47)	2.05 (0.24)		17.38 (0.84)	1.45 (0.08)		13.63 (3.90)	1.28 (0.37)

Table S4. Derived Olson model's parameters for $total_{FFL}$ and $surface_{FFL}$. Model scenarios were categorised by forest cover and burn severity. The *All* category indicates the average of all burn severity levels combined. X_{ss} is the steady-state level of FFL and X_i is the post-fire remaining FFL. Modelled k values are with their standard errors (s.e.). RSE is the model Residual Standard Error and $T_{0.95}$ time to reach 95% of X_{ss}.

Fuel variable	**Closed forest (n = 195)**					**Open forest (n = 261)**					**Woodland (n = 115)**				
Severity	X_{ss} (t ha^{-1})	X_i (t ha^{-1})	k (s.e.)	RSE (t ha^{-1})	$T_{0.95}$ (year)	X_{ss} (t ha^{-1})	X_i (t ha^{-1})	k (s.e.)	RSE (t ha^{-1})	$T_{0.95}$ (year)	X_{ss} (t ha^{-1})	X_i (t ha^{-1})	k (s.e.)	RSE (t ha^{-1})	$T_{0.95}$ (year)
$Surface_{FFL}$															
Low	15.41	5.55	0.46 (0.17)	6.70	5.58	11.58	4.17	0.53 (0.19)	5.72	4.82	9.36	3.37	0.74 (0.27)	3.16	3.44
Medium	15.41	4.31	0.27 (0.06)	5.12	9.79	11.58	3.24	0.31 (0.07)	5.19	8.57	9.36	2.62	0.37 (0.25)	4.70	7.25
High	15.41	1.08	0.19 (0.08)	10.54	15.12	11.58	0.81	0.19 (0.04)	5.20	15.08	9.36	0.65	0.19 (0.05)	4.29	15.53
All	15.41	4.32	0.26 (0.05)	6.95	10.38	11.58	3.62	0.25 (0.03)	4.74	10.66	9.36	2.70	0.22 (0.06)	5.51	11.83
$Total_{FFL}$															
Low	24.14	11.76	0.52 (0.16)	6.25	4.50	18.84	8.98	0.63 (0.19)	5.64	3.73	14.90	7.14	0.71 (0.24)	3.62	3.32
Medium	24.14	9.57	0.28 (0.06)	7.50	8.84	18.84	7.51	0.50 (0.13)	6.73	5.02	14.90	5.53	0.40 (0.16)	3.95	6.33
High	24.14	2.05	0.18 (0.04)	8.61	15.80	18.84	1.45	0.20 (0.02)	4.61	14.79	14.90	1.28	0.20 (0.06)	7.82	14.42
All	24.14	9.36	0.33 (0.06)	9.22	7.68	18.84	7.89	0.28 (0.03)	5.19	8.69	14.90	5.65	0.26 (0.07)	7.21	9.70

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