Relationship between floodplain black box (*Eucalyptus largiflorens*) woodlands and soil condition on the Pike River Floodplain.

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29 July 2010

SARDI Publication Number F2010/000634-1

SARDI Research Report Series No. 479

Government of South Australia

South Australian
Murray-Darling Basin
Natural Resources
Management Board

This Publication may be cited as:

Gehrig, S. L. and Nicol, J.M. (2010). Relationship between floodplain black box (*Eucalyptus largiflorens*) woodlands and soil condition on the Pike River Floodplain. South Australian Research and Development Institute (Aquatic Sciences), Adelaide, 23pp. SARDI Publication Number F2010/000634-1. SARDI Research Report Series No. 479.

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Printed in Adelaide July 2010

SARDI Aquatic Sciences Publication Number F2010/000634-1
SARDI Research Report Series Number 479

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Date:	29 July 2010
Distribution:	SAMDBNRM Board, MDBA, DENR, DFW and SARDI Aquatic Sciences Library
Circulation:	Public Domain

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Acknowledgements

The authors would like to thank Kelly Marsland and Arron Strawbridge for assistance in the field, Rod Ward for laboratory analysis, Kathleen Beyer, Rod Ward, Brad Hollis and Kelly Marsland for comments on early drafts of this report and Cheryl and Iain Coombes and Ivan Marschall for access to their properties. This project was funded by the South Australian Murray Darling Basin Natural Resources Management Board.

Executive Summary

The Pike River Floodplain is a complex, anabranch system off the main channel of the River Murray (South Australia) between the townships of Paringa and Lyrup. The system supports a diversity of aquatic and floodplain habitats. Whilst it is one of the three largest, remaining floodplain systems on the lower River Murray, its overall condition is at risk due to altered flow regimes, elevated highly saline groundwater, obstructions to fish passage, grazing and pest plants and animals. In particular, river red gum (*Eucalyptus camaldulensis*) and black box (*E. largiflorens*) woodlands are in a 'stressed' to 'very poor' condition (Wallace 2009).

The decline of floodplain eucalypts across the Murray-Darling Basin is not uncommon and is primarily related to pressures such as desiccation and salinisation of floodplain soils and secondary pressures such as grazing, climate change, topography, soil type and the presence and condition of understorey vegetation (MDBC 2003; Overton and Jolly 2004; MDBC 2005). Therefore, management actions that involve watering (filling temporary wetlands by pumping or weir pool manipulations) have been found to be an effective intervention tool to arrest the decline (or improve) floodplain eucalypt condition during periods of low flow (Holland *et al.* 2009), but these actions are unlikely to be available for the Pike River Floodplain in the short to medium term. Hence it has been suggested that rain derived soil moisture may be capable of sustaining floodplain areas in the interim (in particular high elevation black box woodlands), but very little was known about the relationship between soil condition and black box woodland condition.

This study investigated soil properties (soil moisture, electrical conductivity, pH and carbon content) and understorey vegetation condition in black box woodland sites on the Pike River Floodplain where black box condition was assessed (Wallace 2009). Results showed that soil condition was highly variable and significantly different between black box woodland sites. However, a comparison of understorey plant communities by cluster analysis identified three distinct groups based on cover of plants species and gross organic matter. Group 1 (a single site) was characterised as having a significantly greater abundance of leaf litter cover compared to percentage cover of vegetation and/or bare soil. Group 2 sites had high soil salinity (EC) at the soil surface (<20 cm), lower (more negative) soil water potentials (<10 cm) and a significantly greater abundance of bare soil. Group 3 sites generally had higher soil moisture, carbon content and (less negative) water potentials at all depths (compared with sites in Group 2) and significantly higher abundances of the chenopod species *Atriplex* spp., *Enchylaena tomentosa, Maireana* spp. and *Sclerolaena stelligera.* Hence, soil moisture was significantly and negatively correlated to bare soil (%), significantly and positively correlated to leaf litter cover, but no significant relationship was found between soil moisture and understorey vegetation cover. These results were related to tree health assessments (Wallace 2009) and whilst trees

were generally in stressed, poor or very poor condition the trees at the site in Group 1 were in better condition than other groups (probably due to high soil moisture and the least negative water potential). Trees at sites in Group 2 were in the poorest condition probably due to low soil moisture, high soil salinity and low (most negative) water potentials.

Results show that high leaf litter cover can act as mulch and reduce evaporation from the soil. Furthermore, the increased soil moisture (compared to bare and vegetated sites) was not restricted to the top 10 cm of soil. Mulching may prove an effective management technique to improve (or arrest the decline in) black box condition by reducing evaporation and increasing water availability. The large areas of eucalypt woodlands, however, make this action impractical. Therefore, large floods are required to improve floodplain soil moisture, reduce soil salinity and improve the condition of floodplain eucalypts, especially high elevation black box woodlands.

1 Introduction

The Pike River floodplain system, situated between the townships of Paringa and Lyrup, is one of the three largest areas of undeveloped floodplain (~ 67 km^{-2}) in the lower River Murray (Nicholls 2009; Marsland 2010). Considered a high conservation value aquatic ecosystem (Commonwealth of Australia 2010), it comprises of numerous ecological assets including a range of aquatic (permanent fast flowing anabranches, slow flowing anabranches, backwaters and temporary billabongs) (Ecological Associates 2008; Beyer *et al.* 2010) and floodplain habitats including river red gum (*Eucalyptus camaldulensis*) and black box (*E. largiflorens*) woodlands, lignum (*Muehlenbeckia florulenta*) shrublands, chenopod (*Atriplex* spp.) shrublands, herblands and dunes (Ecological Associates 2008; Commonwealth of Australia 2010).

Water continuously flows through two inlets above Lock and Weir number 5, filling Mundic Creek, the Upper Pike River, associated billabongs and minor creeks, as well as inundating low-lying woodlands and wetlands (at high water levels), before rejoining the River Murray via the Lower Pike River (Ecological Associates 2008; Commonwealth of Australia 2010). Floodplain woodlands are an important component of the Pike River system. Red gum woodlands are generally located in close proximity to permanent surface or groundwater sources (e.g. the edges of the main river channel and permanent waterbodies) (Bacon *et al.* 1993; Cunningham *et al.* 2009) whilst black box trees are distributed across the floodplain often forming open woodlands at higher elevations (relative to river red gums) and fringing ephemeral wetlands and watercourses (Slavich *et al.* 1999; Overton and Jolly 2004).

Wallace (2009) assessed river red gum and black box condition on the Pike River Floodplain and whilst some individual trees recorded a "good' condition score overall tree condition across the floodplain was either "very poor", "poor" or "stressed". These results are not unusual, since dieback of floodplain eucalypts is currently widespread across the Murray Darling Basin (MDB) (MDBC 2003; MDBC 2005). Some of the primary drivers affecting tree condition are related to the desiccation of floodplain soils as a result of the current hydrological regime imposed by river regulation and abstraction (Thoms and Walker 1993). Floodplain eucalypts are facultative water users; capable of interchangeably (or simultaneously) using deep, saline groundwater sources or fresher soil water and/or surface water sources following flooding and bank recharge (Jolly and Walker 1996; Holland *et al.* 2006) and high rainfall and heavy dew episodes (Mensforth *et al.* 1994; Gehrig 2010). Despite this plasticity in water use, long-term water deficits (from lack of flooding and/or drought) increase reliance on groundwater sources, consequently if groundwater sources are unavailable (or saline), eucalypts may shows signs of dieback as a result of shedding leaves and/or branches to reduce transpiration (MDBC 2003). In addition to rising saline groundwater, other factors affecting tree condition include increased salt accumulation in floodplain soils and the prevention of salt leaching from plant root zones (Jolly *et al.* 2002). Further compounding pressures include grazing, drought, topography (high versus low elevation), soil type and the presence and condition of understorey vegetation (Lane and Associates 2005).

To improve (or arrest the decline of) floodplain eucalypt condition during periods of low flow, regular watering (filling temporary wetlands by pumping, weir pool manipulations or, where possible, gravity feeding) is an effective management intervention tool (Holland *et al.* 2009). In particular, river management strategies that frequently replenish low-salinity soil-water sources beyond the immediate zone of river margins are likely to improve the persistence and regeneration of both native riparian and floodplain communities (George *et al.* 2005; Jensen *et al.* 2008). Unfortunately these actions are not likely to be available for the Pike River floodplain in the short to medium term (Brad Hollis, *pers. comm.*). However, there may be potential to improve tree condition, in the short term, without watering interventions. During the tree condition survey, Wallace (2009) found that many of the trees physiologically responded to increased water availability (epicormic growth) as a result of rainfall runoff and subsequent localised groundwater recharge, despite the lack of recent flooding. This was observed especially in black box trees growing at higher elevations on the edges of the floodplain.

One possible factor contributing to the positive response in tree condition to localised rainfall at higher elevations was the above average natural organic matter (NOM) load (high ratio of shed leaves to twigs and bark) associated with these sites relative to the mean NOM loading rates (~663 g m^{-2}) found for other black box sites across the Pike River Floodplain (Baldocchi and Xu 2007; Wallace 2009). Organic matter provides a range of functions that benefit soil properties, including improving water holding capacity (Table 1). Hence, in the absence of overbank flooding, management actions aimed at improving rain derived soil moisture may also be capable of sustaining floodplain areas (such as high elevation black box woodlands) in the short to medium term. However, at present very little is known about the relationship between soil condition and the condition of black box woodlands. Therefore the aim of this study was to investigate the relationships between soil properties and black box condition on the Pike Floodplain.

Table 1: Summary of function and benefits of natural organic matter in soil (summarised from Black 1968).

Function	Benefit
Physical	Binds soil particles in stable aggregates
	Influences water holding capacity and aeration
	Minimises soil temperature fluctuations
Chemical	Allows cation exchange
	Buffers pH
	Binds heavy metals and pesticides
Biological	food source for microbes and small animals
	major reservoir of plant nutrients

2 Methods

2.1 Site selection

Sites were selected from black box woodland sites assessed by Wallace (2009) (Figure 1), in areas with silty loam/clay soils that are common throughout the Pike River Floodplain. Sites in areas with sandy soils were excluded to avoid confounding effects of soil texture.

2.2 Understorey vegetation surveying protocol

Three 2 x 5 m quadrats (separated by 1 m) were established at the centre of each site. Cover and abundance of each species present, leaf litter and bare soil within each quadrat were estimated using the method outlined in Heard and Channon (1997), except that the scores N and T were replaced by 0.1 and 0.5 to enable statistical analyses (Table 2).

Table 2: Modified (Braun-Blanquet 1932) scale estimating cover/abundance as per Heard and Channon (1997).

Score	Modified Score	Description
N	0.1	Not many, 1-10 individuals
T	0.5	Sparsely or very sparsely present; cover very small (less than 5%)
1	1	Plentiful but of small cover (less than 5%)
2	2	Any number of individuals covering 5-25% of the area
3	3	Any number of individuals covering 25-50% of the area
4	4	Any number of individuals covering 50-75% of the area
5	5	Covering more than 75% of the area

2.3 Plant identification and nomenclature

Plants were identified using keys in Cunningham *et al.* (1981), Jessop *et al.* (2006) and Jessop and Tolken (1986). In some cases plants were identified to genus only due to immature individuals or lack of floral structures. Nomenclature follows Barker *et al.* (2005).

2.4 Soil analyses

Within each quadrat (see section 2.2), three replicate soil samples (~500 g) were collected from depths 0-10, 10-20 and 30-40 cm using a 50 ml Dormer soil auger (n = 9 samples per site). Soil samples were placed into airtight containers and transported to South Australian Aquatic Sciences Centre at West Beach, where the following analyses were conducted: total soil moisture (gravimetric) (Klute 1986; Rayment and Higginson 1992), soil water potential (filter paper technique) (Greacen *et al.* 1986) and electrical conductivity and pH (1:5 soil water extract) (Raymond and Higginson 1992). In addition, soil organic content was determined using the "loss on ignition" (LOI) technique described in Standard Methods (2000), where ~20 g samples were weighed into 35 ml volume ceramic crucibles and then ignited to a constant weight at 550ºC in a muffle furnace. Measurements of organic content (volatile solids lost on ignition) were calculated as a percentage of fixed solids.

2.5 Data analysis

Soil variables between sites were compared using PERMANOVA (Anderson 2001). Comparison of the understorey plant community between sites was undertaken using Group Average Clustering, Indicator Species Analyses (Dufrene and Legendre 1997) and NMS ordination using the packages PCOrd version 5.12 (McCune 2006) and PRIMER version 6.1.12 (Clarke and Gorley 2006). Environmental variable vectors were overlayed on the NMS ordination using Spearman Rank Correlations. Separate regression analyses were undertaken to compare the relationship between soil moisture and percentage cover of: bare soil, leaf litter and understorey vegetation (Sigma Plot version 8.02).

Bray-Curtis (1957) similarities were used for all multivariate analyses where species composition was compared and Euclidean distances were used for PERMANOVA analyses on all non-biological data. For all statistical analyses α=0.05, and was corrected for multiple comparisons (where appropriate) using the Bonferroni correction (Quinn and Keogh 2002).

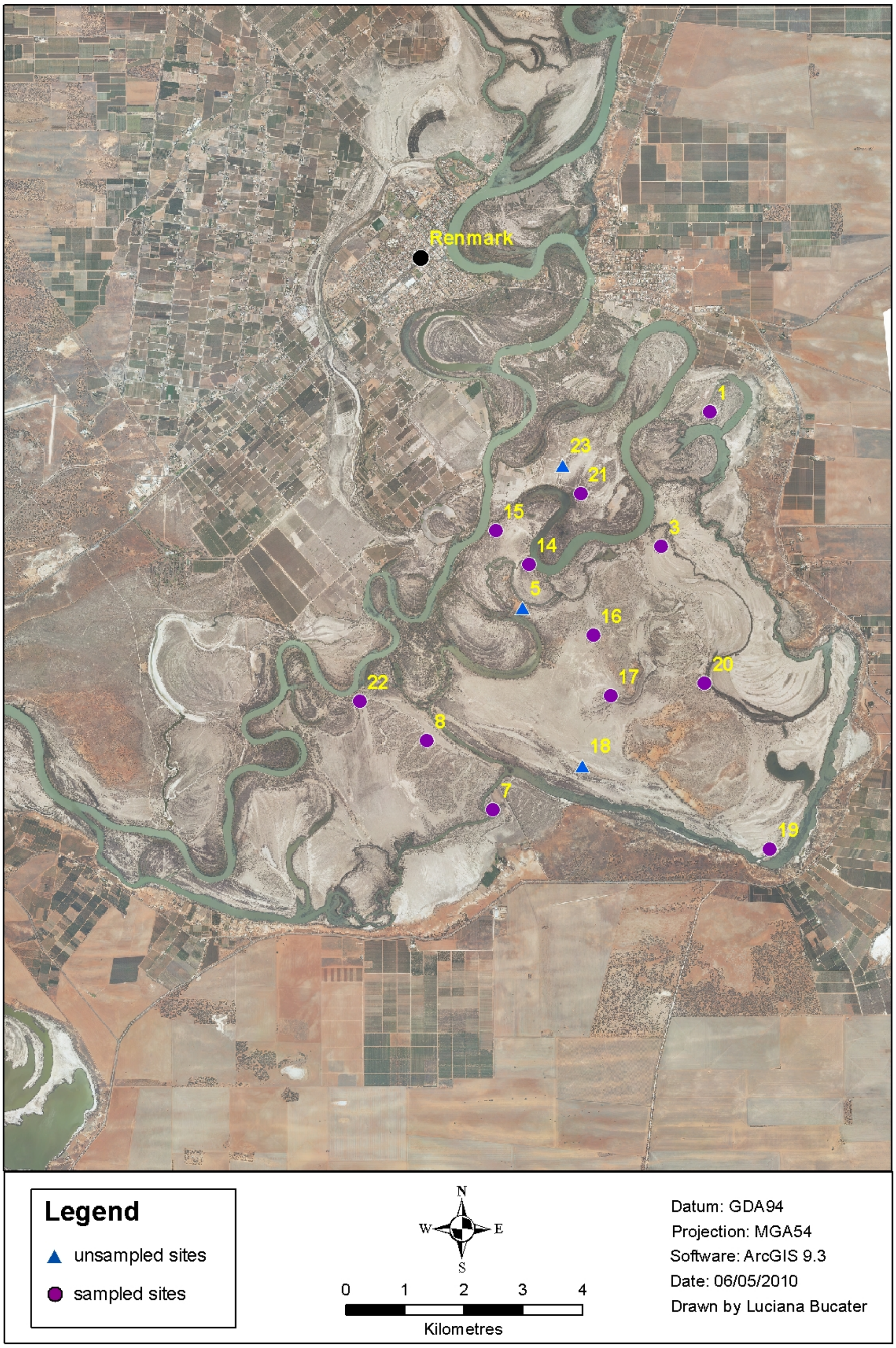

Figure 1: Map of Pike River Floodplain showing the location of sites that were sampled for understorey vegetation and soil condition within the black box (*Eucalyptus largiflorens*) woodland sites previously established by Wallace (2009).

3 Results

3.1 Understorey vegetation

A total of 11 taxa were recorded, including chenopods *Atriplex* spp., *Enchylaena tomentosa*, *Maireana* spp., *Salsola kali, Sclerolaena brachyptera, Sclerolaena divaricata* and *Sclerolaena stelligera*, shrubs *Muehlenbeckia florulenta* and *Eremophila divaricata*, native succulent ground cover *Carpobrotus rossii* and exotic groundcover *Mesembryanthemum crystallinum*. Although some individual quadrats had moderate vegetation or leaf litter cover scores (up to 60%), the overall mean scores for transects were highly variable and mostly bare (Table 3).

Table 3: Percentage cover of bare soil, leaf litter or vegetation in Pike River Floodplain black box woodlands, expressed as mean ± S. E. (range in parentheses).

Site #	Bare soil	Leaf Litter	Vegetation
1	40 ± 5.77 (30-50)	46.67 ± 3.33 (40-50)	13.33 ± 3.33 (10 – 20)
3	92.67 ± 1.33 (90 – 94)	1 ± 0 (1)	6.33 ±1.33 (5 – 9)
7	38.33 ± 7.27 (25 – 50)	16.67 ± 4.41 (10 – 20)	45 ± 10.41 (25 – 60)
8	61.67 ± 11.67 (50 – 85)	16.67 ± 3.33 (10 – 20)	21.67 ± 8.33 (5 – 30)
14	33.3 ± 12.02 (10 – 50)	40 ± 10 (30 – 60)	26.67 ± 3.33 (20 – 30)
15	70 ± 10.41 (50 - 85)	18.33 ± 6.01 (10 – 30)	11.67 ± 4.41 (5 – 20)
16	83.33 ± 3.33 (80 – 90)	1 ± 0 (1)	15.67 ± 3.33 (9 – 19)
17	53.33 ± 12.02 (30 – 70)	10 ± 0 (10)	36.67 ± 12.02 (20 – 60)
19	88.67 ± 5.81 (78 – 98)	7.33 ± 6.33 (1 – 20)	4 ± 2.52 (1 – 9)
20	94 ± 0 (94)	5 ± 0 (5)	1 ± 0 (1)
21	46.67 ± 16.67 (30 - 80)	26.67 ± 8.82 (10 – 40)	26.67 ± 8.82 (10 – 40)
22	40 ± 11.55 (20-60)	40 ± 5.77 (30-50)	20 ± 5.77 (10 – 30)

3.2 Soils

Between site comparisons

Soil properties were highly variable (Appendix 1) and differed significantly (PERMANOVA: $Psuedo\text{-}F_{11,\ 35}$ =6.79, P=0.001) between sites across the Pike River Floodplain. Nevertheless, three groups (at a similarity of 65%) were identified by cluster analysis comparing the understorey plant community (Figure 2). Group 1 was characterised by a single site (site 14), and not defined by any particular soil properties, although Indicator Species Analysis showed that ground cover was predominantly leaf litter and *Eremophila divaricata*. Sites representing Group 2 had high soil salinity (EC) in soil surface (0-10 and 10-20 cm) and lower (more negative) soil water potentials at 0-10 cm (Figure 3). Indicator Species Analysis also showed that sites in Group 2 had a significantly higher abundance of bare soil. NMS ordination showed that Group 3 sites generally had higher soil moisture, carbon content and water potentials at all depths (Figure 3). Indicator Species Analysis showed that Group 3 sites had significantly high abundances of the chenopod species *Atriplex* spp., *Enchylaena tomentosa, Maireana* spp. and *Sclerolaena stelligera.*

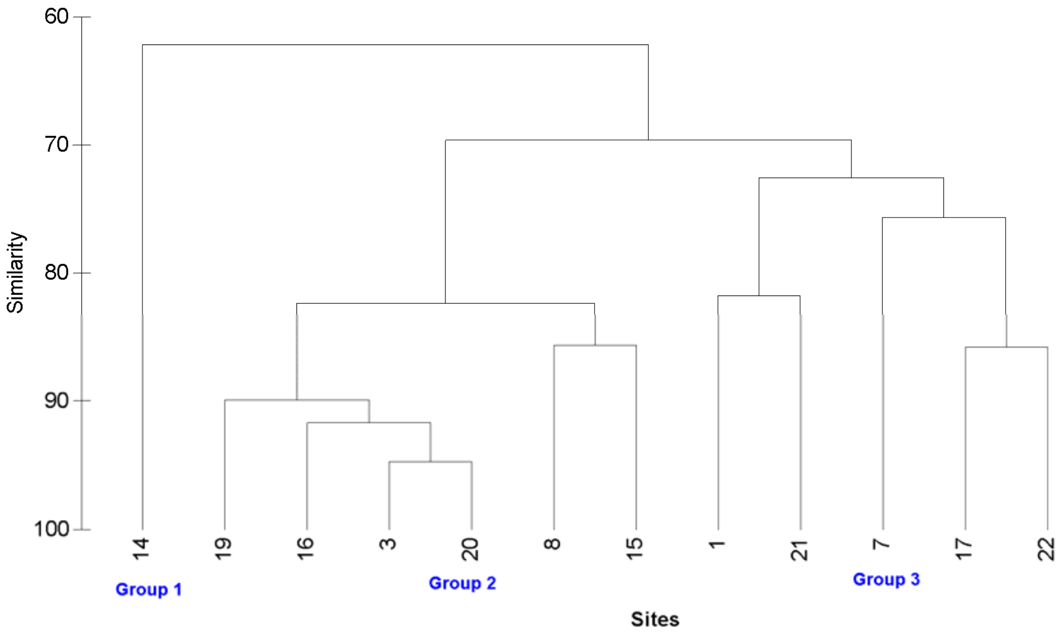

Figure 2: Group average cluster of black box woodland sites based on soil properties and percentage ground cover (bare soil, leaf litter and understorey vegetation) on the Pike River floodplain in 2010.

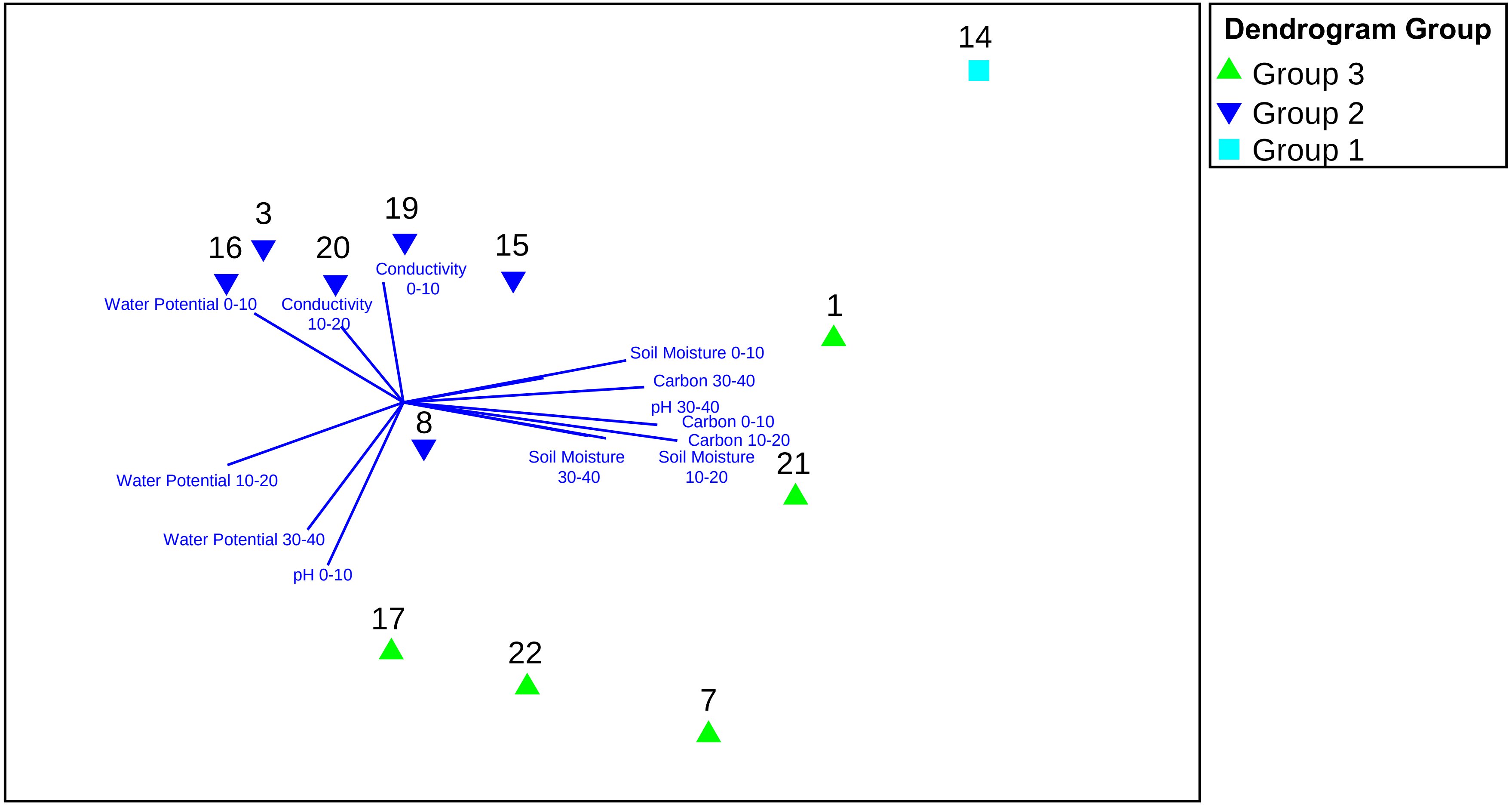

Figure 3: NMS ordination comparing percent ground cover (bare soil, leaf litter and understorey plant species) with soil factors overlayed using Spearman correlation coefficients for black box woodland sites on the Pike River Floodplain (stress=0.09).

Within site comparisons

Within sites, soil moisture ranged from 0.028 to 0.096 g g^{-1} at the surface (0 – 10 cm) and increased with depth (10 – 20cm: 0.076 to 0.141 g g^{-1} and 30-40 cm: 0.095 - 0.192 g g^{-1}) (Appendix 1). Conductivity was also higher at the surface (0 – 10 cm: 850 - 7678 µS.cm^{-1}) and decreased with depth (10 – 20 cm: 1175 - 6610 µS.cm^{-1}; 30 – 40 cm: 1147 – 5948 µS.cm^{-1}). Similarly, carbon content tended to be higher in the surface layer (range 0-10 cm: 3.57-11.46%) than in the deeper layers (10-20 cm: 3.2 -7.24% and 30-40 cm: 2.92 - 4.95%). Alternatively, soil water potentials were lower (more negative) at the soil surface (range 0-10 cm: -99.23 to -207.74 MPa) compared to the deeper layers (10 – 20 cm: -63.13 to -5.69 MPa and 30 – 40 cm: -1.20 to -15.60 MPa). There were no general trends between pH and soil depth within sites. At sites 8 and 17, pH decreased with increasing depth, whereas pH increased with increasing depth for the remaining sites (Appendix 1).

Soil moisture and ground cover relationships

There was a significant negative (r^2 = 0.1 to 0.34) relationship between soil moisture and bare soil (%) for all depths (Table 4; Figure 4). In contrast there was a significant positive, (r^2 = 0.2 to 0.42) relationship between soil moisture and leaf litter cover (%) for all depths (Table 4; Figure 5). However, there was no significant relationship between vegetation cover and soil moisture at any depth (Table 4; Figure 1).

Table 4: Regression *F*-statistic results comparing ground cover and soil moisture for each depth.

Ground cover	Soil Depth	*df*	*F*	*P*
Bare Soil	0-10 cm	1, 35	3.9	0.50
	10 -20 cm	1, 35	17.47	0.0002
	30 – 40 cm	1, 35	8.58	0.006
Leaf Litter	0-10 cm	1, 35	8.73	0.006
	10 -20 cm	1, 35	24.85	<0.001
	30 – 40 cm	1, 35	9.01	0.005
Vegetation	0-10 cm	1, 35	0.063	0.810
	10 -20 cm	1, 35	2.47	0.125
	30 – 40 cm	1, 35	2.12	0.145

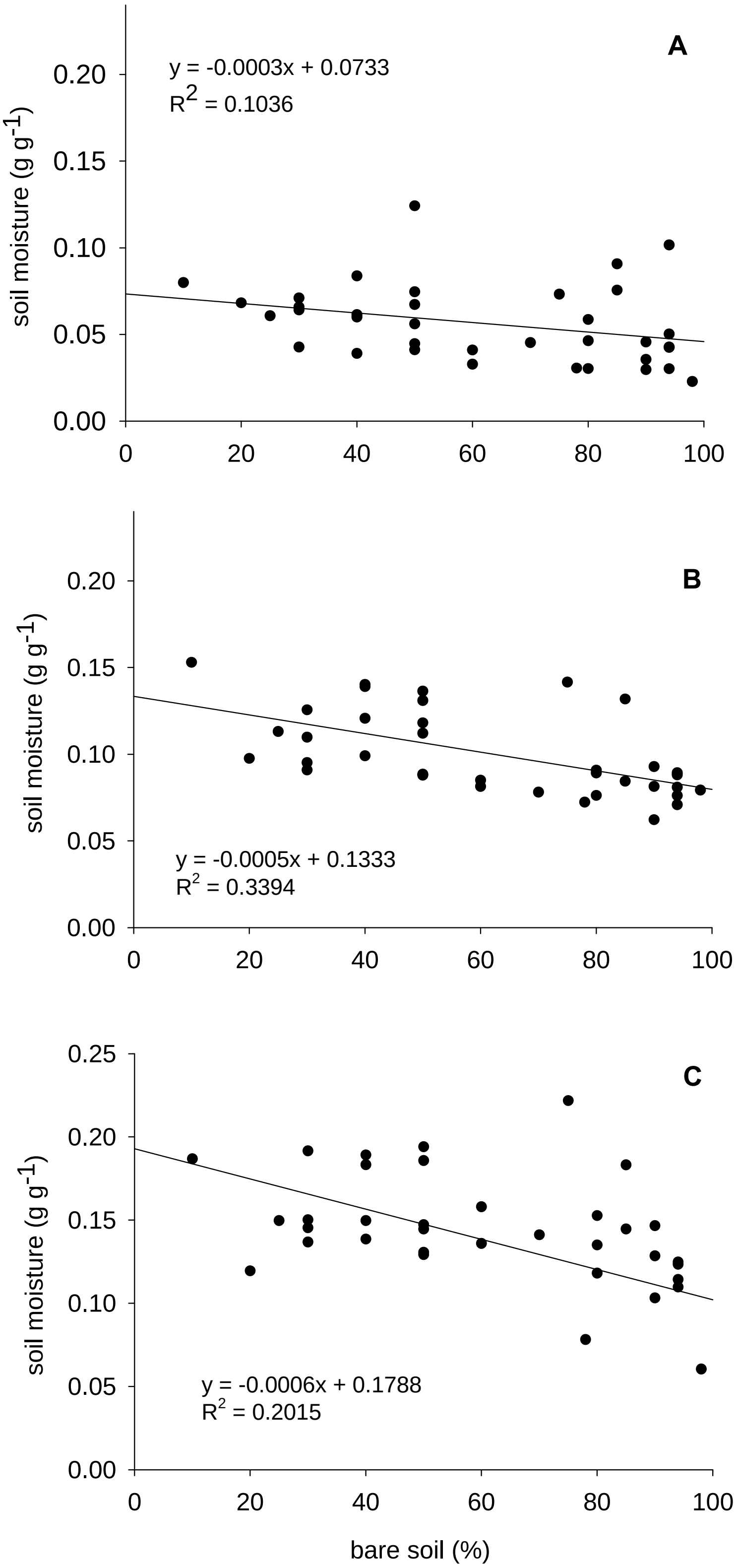

Figure 4: Relationship between soil moisture (g g^{-1}) and bare soil (%) at soil depths of 0 – 10 cm (A), 10 – 20 cm (B) and 30 – 40 cm (C) from soil samples collected in Pike river black box woodlands (*n* = 108).

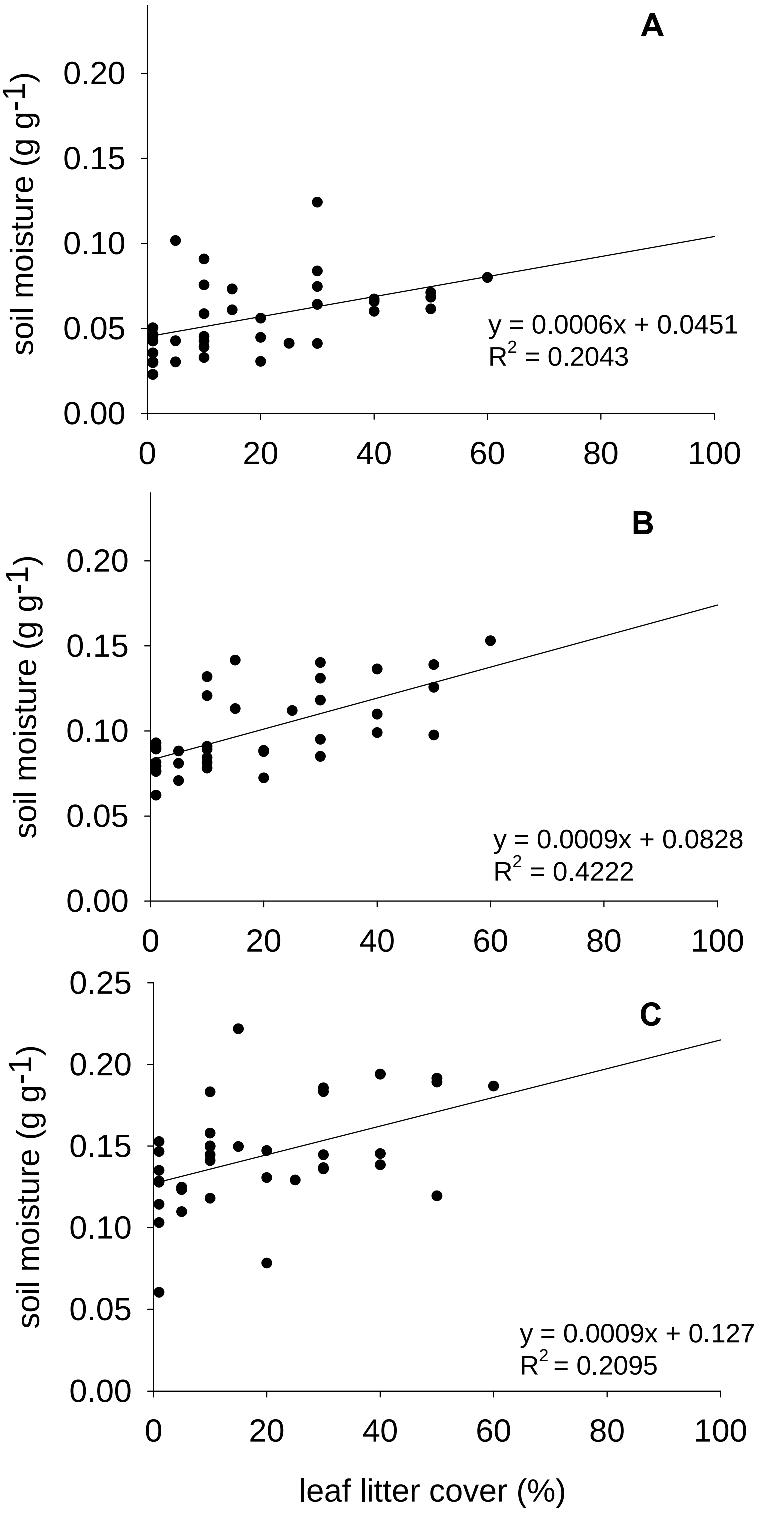

Figure 5: Relationship between soil moisture (g g^{-1}) and leaf litter cover (%) at soil depths of 0 – 10 cm (A), 10 – 20 cm (B) and 30 – 40 cm (C) from soil samples collected in Pike river black box woodlands (*n* = 108).

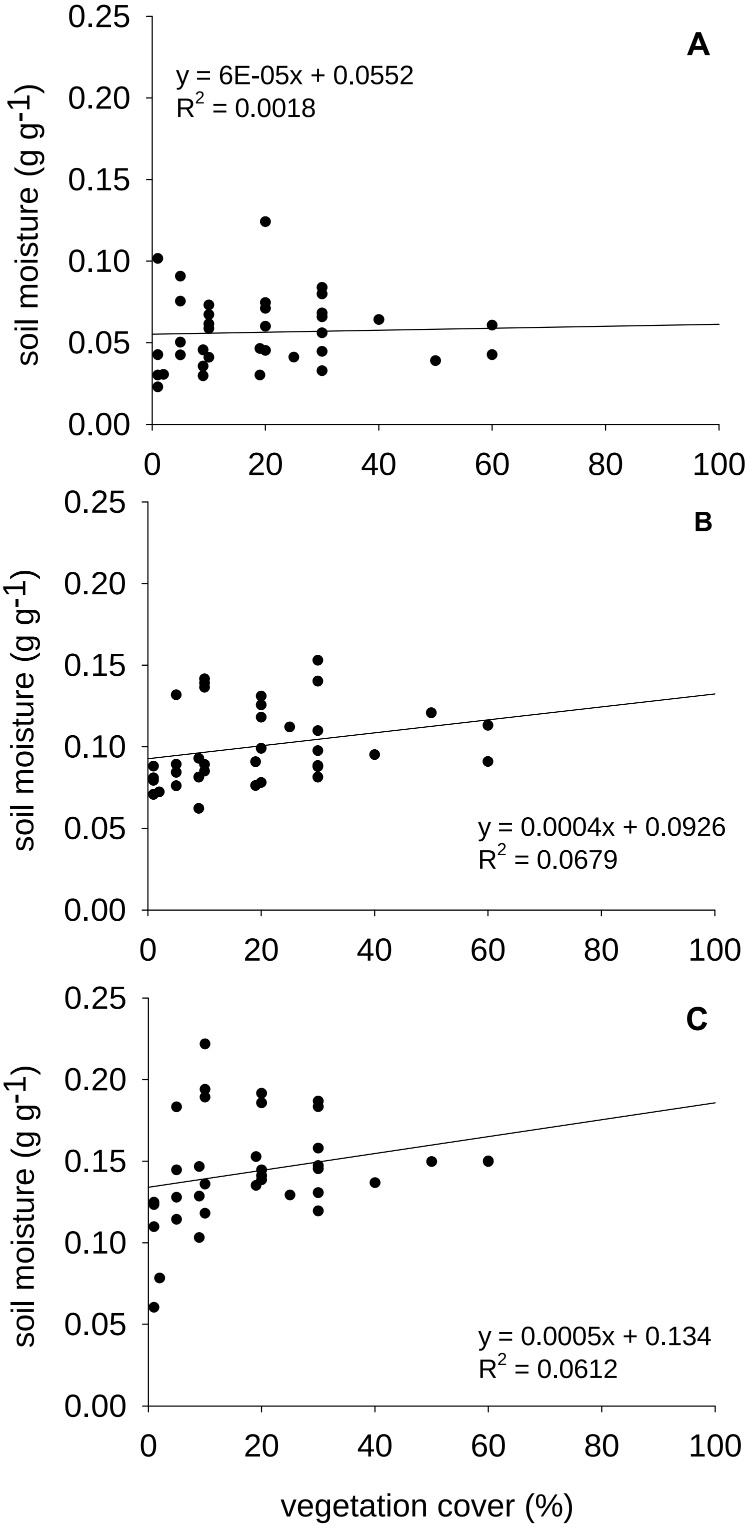

Figure 6: Relationship between soil moisture (g g^{-1}) and vegetation cover (%) at soil depths of 0 – 10 cm (A), 10 – 20 cm (B) and 30 – 40 cm (C) from soil samples collected in Pike river black box woodlands (*n* = 108).

4 Discussion

Soil condition in black box woodlands on the Pike River Floodplain was highly variable, which most likely reflects the variability in ground cover type and abundance throughout the woodlands. This was evident in relation to soil moisture, where an increase in soil moisture was positively related to an increase in leaf litter cover. Only one site (site 14) was characterised as having a significantly greater abundance of leaf litter cover compared to percentage cover of vegetation and/or bare soil. According to the assessment by Wallace (2009), black box trees within this site also had the highest median tree condition score compared to all other sites on the Pike River Floodplain (although trees were still considered "stressed"). Within site 14, trees also recorded more positive attributes (new tip growth, epicormic growth) compared to negative attributes (leaf die-off); suggesting a positive potential trajectory in tree condition between assessments (Wallace 2009).

In contrast, a decrease in soil moisture was related to an increase in the percentage cover of bare soil. Group 2 sites had significantly more bare soil, and assessments by Wallace (2009) showed that trees within these sites were in "poor" to "very poor" condition, possessing more negative attributes compared to positive attributes (signifying a negative potential trajectory in tree condition between assessments) (Wallace 2009). In addition, these sites were characterised by higher soil electrical conductivity (especially at the soil surface). However, the conductivity values were still considered moderate and well within the tolerance range (< 10,000 $\mu S.cm^{-1}$) of most chenopod species (e.g. *Atriplex* spp., *Sclerolaena* spp.) (Hassam 2007) which suggests the lack of vegetation and prevalence of bare soil may be related to other factors such as low soil moisture and grazing.

There was no relationship between soil moisture and percentage cover of vegetation. Where there was a significantly higher percentage cover of vegetation compared to other ground cover types (Group 3), the species present were salt and drought tolerant terrestrial chenopods such as *Atriplex* and *Sclerolaena* spp. Black box within Group 2 sites were in "very poor" condition (with the exception of site 7, where trees were "stressed") (Wallace 2009), but tended to have slightly more positive attributes compared to negative attributes, suggesting a trend towards a positive (or at the very least stable) potential trajectory in tree condition between assessments (Wallace 2009). The ambiguous relationship between soil moisture and the presence of understorey vegetation was not unexpected. While there are studies that illustrate that an increase in understorey vegetation can decrease the amount of soil-water available to the overstorey (as a result of competitive interactions) (Kume *et al.* 2003; Takahashi *et al.* 2003), there are others that show that the presence of understory may be relatively benign (Ishii *et al.* 2008; Zou *et al.* 2005).

Electrical conductivity measurements were generally higher in the upper surfaces compared to deeper depths, and especially in sites where the abundance of vegetation and leaf litter cover was minimal and/or absent (Group 2). This most likely reflects a higher rate of evaporation and concentration of solutes at the surface of bare soil patches. A lack of overbank flooding and extended drought conditions across the Murray-Darling Basin are also likely to have contributed to low soil moisture conditions and an associated accumulation of salts in the root zone of many areas of the Pike River Floodplain (*sensu* Overton and Doody 2010). Other soil properties such as pH and total carbon did not appear to influence tree condition.

4.1 Management implications

Wallace (2009) proposed that the black box woodlands within the Pike River Floodplain are likely to deteriorate without above average rainfall and/or flooding in the next three years and therefore require direct management intervention. At present, the management action of watering temporary wetlands is not available for the Pike River Floodplain (especially in the short to medium-term). However, other management actions, such as stock exclusion and mulching may maintain or increase soil moisture in the upper surface (>40 cm) and benefit tree condition.

Rosicky *et al.*(2006) investigated the effectiveness of stock exclusion and mulching in facilitating revegetation of degraded floodplain systems (affected by acid sulphate soils) in New South Wales. In this instance, mulching was found to be the single most important treatment, significantly increasing understorey vegetation biomass within the first year after implementation. Mulching treatment also improved soil moisture and salinity, especially in the upper soil layers (<10 cm). Stock exclusion as a stand alone treatment was found to be the least effective technique, but revegetation was significantly enhanced when used in combination with mulching. However, mulching a large area such as the Pike River Floodplain may only be feasible for small areas. Similarly, revegetation is also not likely to be a feasible option for the Pike River Floodplain given the low soil moisture. Nevertheless, results from this study suggest that soil condition has not deteriorated to a point where re-establishment of floodplain/amphibious species could be achieved by watering or natural flooding (e.g. salinity values do not exceed tolerance levels of common vegetation species) (Nicol *et al.* 2010). Therefore, improvements in black box woodland and understorey condition are currently dependent on overbank flooding.

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Appendix 1: Soil parameter values (mean ± S. E.) for each black box woodland site and soil depth (cm).

Site #	Soil depth (cm)	Soil Moisture (g g^{-1})	Soil water potential (MPa)	Conductivity (µS.cm^{-1})	pH	Carbon content (%)
1	0-10	0.067 ± 0.003	174.70 ± 19.28	7140 ± 341.52	5.67 ± 0.03	6.51 ± 0.28
	10-20	0.134 ± 0.004	5.69 ± 0.68	5466.67 ± 419.12	5.89 ± 0.03	5.68 ± 0.49
	30-40	0.192 ± 0.001	1.20 ± 0.07	4948.33 ± 239.07	6.90 ± 0.03	4.37 ± 0.40
3	0-10	0.043 ± 0.004	139.11 ± 7.53	7678.33 ± 905.40	6.41 ± 0.09	3.79 ± 0.27
	10-20	0.076 ± 0.008	47.86 ± 20.91	6610 ± 299.39	6.21 ± 0.05	3.63 ± 0.12
	30-40	0.115 ± 0.007	3.67 ± 1.17	5948.33 ± 273.64	5.46 ± 0.11	2.92 ± 0.07
7	0-10	0.047 ± 0.007	110.56 ± 12.58	1590 ± 101.28	6.54 ± 0.16	6.31 ± 0.05
	10-20	0.115 ± 0.003	19.84 ± 2.83	2768.33 ± 408.79	7.38 ± 0.42	4.77 ± 0.08
	30-40	0.143 ± 0.007	5.42 ± 1.02	3675 ±221.41	8.14 ± 0.46	3.20 ± 0.25
8	0-10	0.059 ± 0.009	113.12 ± 8.18	2233.33 ± 66.75	5.96 ± 0.12	4.83 ± 0.24
	10-20	0.087 ± 0.001	34.50 ± 7.55	2006.67 ± 181.88	5.18 ± 0.14	4.98 ± 0.46
	30-40	0.141 ± 0.005	2.99 ± 0.19	2023.33 ± 178.78	4.65 ± 0.02	4.33 ± 0.44
14	0-10	0.096 ± 0.014	99.23 ± 33.96	1858.33 ± 583.14	5.54 ± 0.06	11.46 ± 1.06
	10-20	0.141 ± 0.006	9.09 ± 0.76	1496.67 ± 267.12	5.83 ± 0.09	7.24 ± 0.22
	30-40	0.185 ± 0.001	3.22 ± 0.73	1921.67 ± 133.87	7.51 ± 0.24	4.22 ± 0.02
15	0-10	0.079 ± 0.006	119.08 ± 22.27	4540 ± 495.13	5.51 ± 0.10	8.32 ± 0.54
	10-20	0.130 ± 0.007	6.82 ± 1.95	2778.33 ± 284.49	5.63 ± 0.09	6.16 ± 1.29
	30-40	0.183 ± 0.022	2.09 ± 0.80	3388.33 ± 292.18	6.41 ± 0.41	4.95 ± 1.24
16	0-10	0.041 ± 0.005	192.42 ± 10.41	2538.33 ± 227.84	5.73 ± 0.03	4.57 ± 0.16
	10-20	0.087 ± 0.005	30.98 ± 7.38	2541.67 ± 282.56	5.48 ± 0.11	4.08 ± 0.16
	30-40	0.139 ± 0.007	7.09 ± 1.46	2771.67 ± 347.19	4.91 ± 0.18	3.91 ± 0.12
17	0-10	0.040 ± 0.004	124.58 ± 6.61	2981.67 ± 1145.76	5.63 ± 0.21	4.27 ± 0.16
	10-20	0.083 ± 0.004	37.49 ± 5.11	2601.67 ± 849.17	4.94 ± 0.08	4.01 ± 0.19
	30-40	0.150 ±0.005	4.65 ± 0.90	2788.33 ± 504.46	4.76 ± 0.09	3.98 ± 0.28
19	0-10	0.028 ± 0.002	207.74 ± 5.47	3246.67 ± 589.60	5.59 ± 0.10	3.57 ± 0.25
	10-20	0.078 ± 0.003	20.84 ± 3.49	3978.33 ± 236.22	5.85 ± 0.10	3.20 ± 0.13
	30-40	0.095 ± 0.026	3.78 ± 1.57	3681.67 ± 847.38	6.56 ± 0.45	2.66 ± 0.23
20	0-10	0.058 ± 0.022	146.50 ± 14.67	1086.67 ± 174.52	6.32 ± 0.43	4.01 ± 0.17
	10-20	0.080 ± 0.005	63.13 ± 18.66	1628.33 ± 214.74	6.17 ± 0.82	4.04 ± 0.22
	30-40	0.119 ± 0.005	15.60 ± 2.98	2001.67± 217.75	5.44 ± 1.08	4.03 ± 0.13
21	0-10	0.063 ± 0.002	141.03 ± 24.28	3721.67 ± 1510.74	5.94 ± 0.01	4.08 ± 0.58
	10-20	0.098 ± 0.006	40.02 ± 12.67	2283.33 ± 912.65	6.02 ± 0.09	6.33 ± 1.53
	30-40	0.133 ± 0.008	8.72 ± 3.46	2861.67 ± 339.34	7.29 ± 0.16	3.90 ± 0.53
22	0-10	0.056 ± 0.008	102.88 ± 24.28	850 ± 184	6.05 ± 0.30	7.46 ± 2.43
	10-20	0.094 ± 0.004	34.99 ± 7.93	1175 ± 184	5.64 ± 0.28	5.46 ± 0.75
	30-40	0.131 ± 0.006	10.55 ± 1.88	1146.67 ±28.51	5.57 ± 0.57	4.22 ± 0.34