FLORISTICS, STAND STRUCTURE AND ABOVEGROUND BIOMASS OF A 25-HA RAINFOREST PLOT IN THE WET TROPICS OF AUSTRALIA

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BRADFORD MG, METCALFE DJ, FORD A, LIDDELL MJ & MCKEOWN A. 2014. Floristics, stand structure and aboveground biomass of a 25-ha rainforest plot in the wet tropics of Australia. Australian wet tropical rainforests are both floristically diverse and high in endemism, and their restricted distribution sees them particularly vulnerable to climate change and other anthropogenic influences. Historically, there were no large-scale studies of the dynamics and drivers of these systems in Australia. We established a 25-ha rainforest plot in the Wet Tropics bioregion of Australia to undertake intensive collection of floristic, structural and ecosystem measurements. An initial census of all stems ≥ 10 cm diameter at breast height (dbh) recorded 23,416 stems from 208 species in 128 genera and 53 families; Lauraceae, Rutaceae, Proteaceae and Elaeocarpaceae were dominant. Endemism was high with 80.3% of species of stems ≥ 10 cm dbh found on the plot endemic to Australia and 45.2% endemic to the Wet Tropics bioregion. We provide the first measured estimate of basal area (52.0 m^2 ha^{-1}) and aboveground living biomass (418.5 Mg ha^{-1}) for a large area of Australian rainforest. The data collected from the 25-ha plot provide a baseline description of floristics and stand structure that will facilitate and encourage long-term ecological research of forest dynamics and allow direct comparisons to be made with similar plots on a global scale.

Keywords: Stem density, basal area, climate change, Queensland, Robson Creek

INTRODUCTION

Tropical rainforests are recognised as valuable for their intrinsic worth, the biodiversity they support, the ecosystem services they provide, their utilitarian worth for timber and non-timber products and the potential that they have for ameliorating the impacts of climate change on the local to global scale. However, we still have limited understanding of their dynamics and capacity to adapt to change, an understanding which requires large-scale, long-term monitoring approaches. An effective option for large-scale, long-term monitoring of forests is the establishment of large focused plots (Condit 1995, 1998, Lindenmayer et al. 2012) and associated observation infrastructure.

In Australia, a small number of large-scale, long-term ecosystem monitoring sites are maintained (Lindenmayer et al. 2014), few of which are located in the tropics and these focusing on savannah communities (e.g. Kutt & Woinarski 2007, Russell-Smith et al. 2010). Although rainforest in Australia only occupies 0.5% of the land mass, it is recognised as an internationally important biome due to high levels of plant and animal diversity and endemism, its disproportionate influence on the water balance and climate, and its suitability for in-situ conservation of threatened species of outstanding universal value (Wet Tropics Management Authority 2013). For these reasons, the wet tropical rainforest of Queensland was chosen to locate a large-scale monitoring plot comparable with other long-term forest plots around the globe (Condit 1998). Previous to the establishment of this plot, long-term monitoring of tropical rainforest was achieved via a series of smaller permanent plots (Metcalfe & Bradford 2008, Theimer et al. 2011, Murphy et al. 2013).

The Wet Tropics bioregion of Australia is situated along the tropical east coast of Australia stretching some 450 km from 15° 40' S to 19° 15' S and covering approximately 2 million ha (Sattler & Williams 1999). The bioregion consists of narrow coastal floodplains flanked by steep mountains to 1600 m above sea level (asl) and contains a mosaic of vegetation types, many associated with particular landforms. North of the bioregion, the forests of Cape York are dominated by sclerophyll vegetation types, with small areas of mostly monsoonal rainforest with a pronounced dry season. South and west of the bioregion the forests become more sclerophyll-dominated in character, and give way to woodlands and savannah as the influence of coastal rainfall diminishes and fire becomes a more important driver of vegetation patterns (Bowman 2000, Metcalfe & Ford 2008).

The Robson Creek 25-ha rainforest plot was established as the centrepiece of the Robson Creek node of the Far North Queensland Rainforest Supersite (TERN 2013). The plot lies in the centre of the Wet Tropics bioregion and was chosen as a representative mid-altitude (700 m asl) site. The census plot is of national value in that it provides the first large-scale investigation of rainforest diversity and forest dynamics in Australia. It is also of global value as it allows direct comparisons with similarly structured plots around the world as part of the Smithsonian Institution's Centre for Tropical Forest Science plot network (Condit 1998). The features of Australian wet tropical rainforests are frequent disturbance by tropical cyclones (hurricanes/typhoons), high levels of floristic and faunal endemism, and floristic and faunal affinities with both Indo-Malayan and Gondwanan taxa (Metcalfe & Ford 2008).

In this paper we provide an analysis of the stems ≥ 10 cm diameter at breast height (dbh) on the Robson Creek 25-ha plot and of the vascular plants of a core hectare within the 25 ha. Data are from the first census, completed in December 2012. The data form a baseline description of diversity and stand structure that will facilitate and encourage long-term ecological research on the plot and allow direct comparisons to be made with similar plots on a global scale.

MATERIALS AND METHODS

Study area

The Robson Creek 25-ha rainforest plot is located approximately 30 km north-east of Atherton, in North Queensland, Australia, 17° 07' S, 145° 37' E, at 680–740 m elevation. It lies in Danbulla National Park within the Wet Tropics World Heritage Area. The plot is moderately inclined with a low relief (Speight 2009) although the Lamb Range rises sharply to 1276 m asl immediately to the north of the plot. Three permanent creeks flow through the plot, joining with Robson Creek which in turn meets the man-made Tinaroo Dam on the Barron River approximately two kilometres south of the plot. LiDAR and hyperspectoral data collection flights were flown in 2012 by the AusCover facility of the Australian Terrestrial Ecosystem Research Network (TERN 2013). Figure 1 shows the resultant contour map of the 25-ha area.

The vegetation on the plot is described as complex mesophyll vine forest on granite and meta-sediment alluvium (Regional Ecosystem (RE) 7.3.36a, Queensland Government 2006), although higher sections of the plot are analogous to simple notophyll vine forest on meta-sediment (RE 7.11.12a). The forest type changes to simple to complex notophyll vine forest on granite (RE 7.12.16a) with increasing altitude to the north of the plot. The parent material on the plot is meta-sedimentary and soil fertility is moderately low. Using the Australian Soil Classification system, the soil has been classified as an acidic, dystrophic, brown dermosol; medium, non-gravelly, clayey/clayey, moderate (Nelson & Liddell 2013, unpublished data).

The climate of the area is considered seasonal with 61% of annual rainfall occurring between January and March (Figure 2; Australian Bureau of Meteorology 2012). Mean annual rainfall at Danbulla Forestry Station (4.5 km south of the plot) is 1597 mm (1921–1991). Mean monthly minimum and maximum temperatures for Kairi Research Station, where the nearest data are collected, are shown in Figure 2 (Australian Bureau of Meteorology 2012). An automatic weather station (Environdata Weathermaster 2000) was set up in 2011 at Robson Creek and the first two complete years of data show comparable intra-annual patterns as those observed at Danbulla Forestry Station and Kairi Research

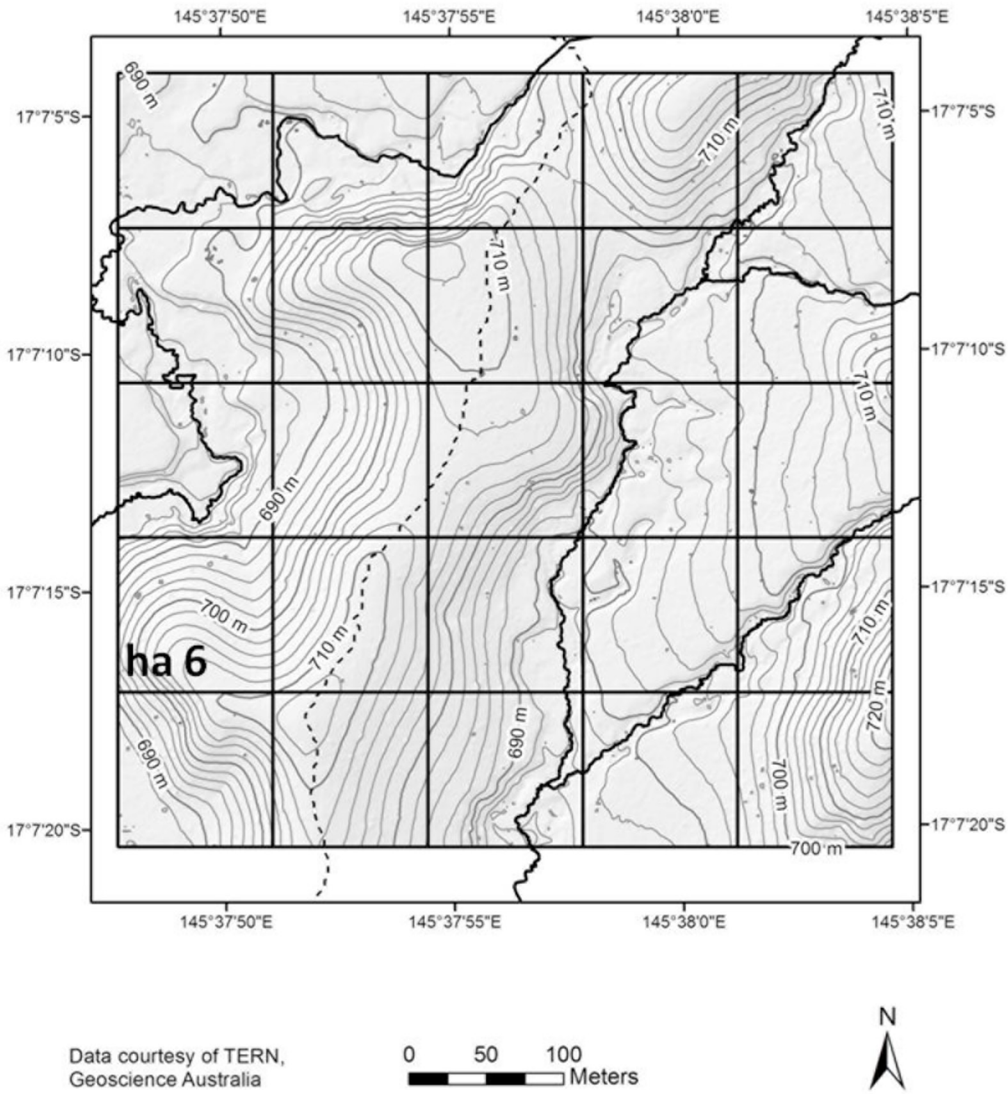

Figure 1 The Robson Creek 25-ha rainforest plot showing 2-m contours, permanent watercourses (solid black lines) and the access track (broken black line) which follows an abandoned logging track; the 100 m × 100 m grid shows each of the 25 ha; the single core hectare (ha 6) is located on the western edge of the plot

Station in both rainfall and temperature. The site may be regarded as moist rather than wet and has an annual mean relative humidity of 82%.

The Robson Creek 25-ha rainforest plot and the Daintree Rainforest Observatory (Laidlaw et al. 2007) comprise the two operational nodes of the Far North Queensland Rainforest Supersite. The Daintree Rainforest Observatory currently comprises two single-hectare lowland rainforest plots with a canopy crane and is situated on the coast 115 km to the north of the Robson Creek plot. The Far North Queensland Rainforest Supersite is one of 10 supersites located across Australia to represent important ecological biomes. Supersites were established as part of the Terrestrial Ecosystem Research Network (TERN) (TERN 2013) through a major infrastructure investment. Data from the supersites can be accessed via the Australian Supersite Network data portal (http://www.tern-supersites.net.au/knb). The plot is also part of the Centre for Tropical Forest Science (CTFS) global network of forest research plots (http://www.ctfs.si.edu).

Disturbance

While the region has been occupied by aboriginal people for at least 8000 years (Hill et al. 2011),

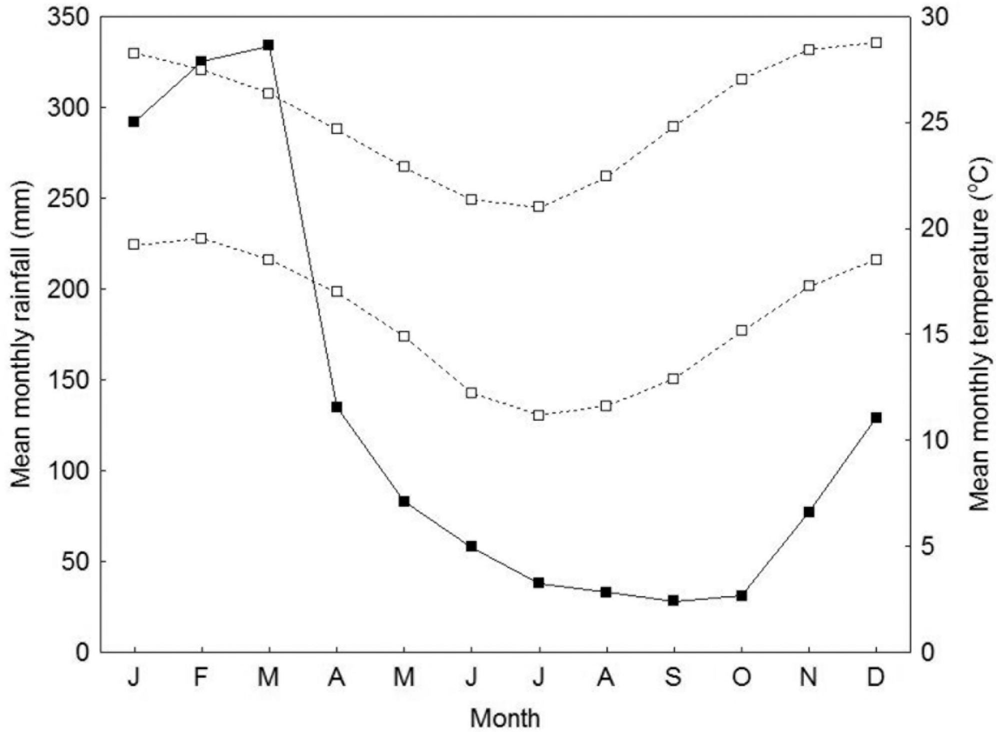

Figure 2 Mean monthly rainfalls (Y left axis, solid line, Danbulla Forestry 1921–1991) and mean monthly maximum and minimum temperatures (Y right axis, broken lines, Kairi Research Station 1913–2011); note the highly seasonal summer-wet, winter-dry patterns of rainfall in the region

traditional use of the Robson Creek area by the Tablelands Yadinji had ceased by the 1960s. Due to the low population density, it is unlikely that the original inhabitants contributed significantly to rainforest dynamics except in small areas, with only very selective timber harvesting, clearing and burning taking place. As is the case for all accessible areas of the Wet Tropics of Australia, the Robson Creek 25-ha plot was selectively logged with the last logging undertaken between 1960 and 1969. The southern and central parts of the plot were logged between 1960 and 1964 while the north-east and north-west corners were logged between 1964 and 1969. Logging frequency and intensity are not available as logging records were not retained; however, logging practices can be inferred from Crome et al. (1992). Of particular interest is that logging was not practised within 10 m either side of watercourses and a species preference list was adhered to. Seven very highly desired and six highly desired species on the preference list are currently present on the plot. Silvicultural treatment of forest in the Wet Tropics was common in the 1950s. Treatments included removal of species not on the preference list, promotion of desired timber species, and retention of larger individuals as seed trees. Although no evidence exists of such treatments on the plot, the presence of such an activity cannot be dismissed.

Plot establishment and census

Each hectare corner of the Robson Creek 25-ha rainforest plot was surveyed to a horizontal plan projection aligned to grid north using a differential Global Positioning System (Trimble Pro XRT using the Omnistar DGPS signal) resulting in an independent precision of each survey point of 2.3 m ± 1.8 SD.

All stems on the 25-ha plot (trees, lianas, ferns, palms, strangler figs) with dbh ≥10 cm were identified to species, mapped, tagged, heighted and the dbh measured. Nomenclature followed Bostock and Holland (2010). Stems were mapped within a 20 m × 20 m subplot to an accuracy of ± 0.5 m. Stems were permanently marked with a tag attached to stainless steel wire encircling the stem for stems < 30 cm dbh or a painted number for all larger stems. Height (length of stem) was measured to ± 0.5 m with a laser rangefinder or estimated against a previously measured tree. The dbh was measured according to protocols outlined in Condit (1998) with one variation: for species known to exhibit buttressing on larger specimens, the point of measurement was pre-emptively elevated above the predicted buttressing influence. The point of measurement was decided by the team leader and was species specific. This may result in minor underestimations of basal area and aboveground biomass. In addition to the ≥ 10 cm dbh stem census, (1) a complete vascular plant inventory was carried out on a single core hectare (ha 6) and (2) basal area and biomass estimations of stems ≥ 1 cm and < 10 cm dbh were determined from dbh and height measurements of these stems in 2 ha. Fieldwork was carried out between December 2009 and November 2012. Voucher specimens are held in the Queensland Herbarium (BRI) and Australian Tropical Herbarium (CNS) with duplicate specimens distributed elsewhere.

Data analysis

Aboveground biomass (AGB) of stems > 10 cm dbh was calculated using the Chave et al. (2005) algorithm for moist forests:

$$AGB = 0.0509 \times \text{wood density} \times \text{dbh}^2 \times \text{height}$$

Wood density values were taken from a database of species from northern Australia (CSIRO unpublished). For stems ≥ 1 cm to < 10 cm dbh the same Chave et al. (2005) algorithm was used and a single wood density value of 0.50 g cm^{-3} was assigned to each stem (the mean wood density value of the plot was 0.56 g cm^{-3}). Diversity measures were calculated using PRIMER 6 following Clarke and Gorley (2006). Relative frequency, relative density, relative dominance and the importance value index for species were calculated for all stems ≥ 10 cm dbh following Curtis (1959). Relative frequency was calculated by hectare. We used the family importance value (Mori et al. 1983) to calculate dominant families as this value stresses species diversity within a family.

RESULTS

Floristics

The 25-ha plot census recorded 23,416 stems ≥ 10 cm dbh consisting of 208 species from 128 genera and 53 families. The most common species were the canopy trees *Litsea leefeana* (Lauraceae) with 7.9% of stems, *Cardwellia sublimis* (Proteaceae) 6.6% and *Flindersia bourjotiana* (Rutaceae) 5.6%. Twenty-five species were represented by a single stem ≥ 10 cm dbh. The most common families were Lauraceae (19.9% of stems), Rutaceae (17.2%) and Proteaceae (14.2%). The number of species per hectare ranged from 82 to 118 (mean 98.2 ± 9.9 SD). Diversity measures for the 25-ha plot are shown in Table 1. The dominant species and families are shown in Tables 2 and 3. Trees contributed 192 species while lianas contributed nine species (27 stems), strangler figs four species (23 stems), epiphytes two species (7 stems), and ferns one species (14 stems). Palms ≥ 10 cm dbh were absent from the plot.

The core 1-ha vascular plant survey revealed 266 species from 189 genera and 82 families. The most common families were Lauraceae (8.8% of species), Sapindaceae (6.6%) and Myrtaceae (6.2%). No exotic species were recorded as stems ≥ 10 cm dbh or on the core hectare; however, two stems of the naturalised *Solanum mauritianum* (Solanaceae), a transient pioneer tree, were found within the 25-ha plot.

Table 1 Stem diversity measures for stems ≥ 10 cm dbh on the Robson Creek 25-ha rainforest plot

N	S	d	J'	H'	1 – ⍰
23,416	208	20.57	0.778	4.15	0.973

N = number of stems, S = total number of species, d = Margalef's species richness index (S – 1)/log N, J' = Pielou's evenness index H'/log S, H' = Shannon diversity index $\sum(P_i \log P_i)$, 1 – ⍰ = Simpsons evenness index 1 – $\sum(N_i/N)^2$

Table 2 The 10 most important species from stems ≥ 10 cm dbh on the Robson Creek 25-ha rainforest plot calculated using the importance value index (Curtis 1959)

Species	D	F	BA	RDe	RF	RDo	Importance value index
Cardwellia sublimis	1540	25	88.32	6.58	1.02	7.87	15.46
Litsea leefeana	1837	25	61.85	7.85	1.02	5.51	14.37
Flindersia bourjotiana	1322	25	72.28	5.65	1.02	6.44	13.10
Flindersia pimenteliana	774	24	60.72	3.31	0.98	5.41	9.69
Elaeocarpus largiflorens subsp. *largiflorens*	953	25	36.10	4.07	1.02	3.22	8.30
Flindersia brayleyana	496	25	47.81	2.12	1.02	4.26	7.40
Doryphora aromatica	596	25	42.32	2.55	1.02	3.77	7.33
Alphitonia whitei	851	25	25.58	3.63	1.02	2.28	6.92
Darlingia darlingiana	687	25	26.50	2.93	1.02	2.36	6.31
Sloanea australis subsp. *parviflora*	507	23	30.11	2.17	0.94	2.68	5.78

D = stem density, F = number of hectares present, BA = basal area (m^2), RDe = relative density, RF = relative frequency, RDo = relative dominance

Table 3 The 10 most important families from stems ≥ 10 cm dbh on the Robson Creek 25-ha rainforest plot calculated using the family importance value (Mori et al. 1983)

Family	N	Ni	BA	RDi	RF	RDo	Family importance value
Lauraceae	4668	30	181.0	0.14	0.20	0.14	50.28
Rutaceae	4019	14	246.8	0.07	0.17	0.22	45.79
Proteaceae	3343	14	174.3	0.07	0.14	0.16	36.43
Elaeocarpaceae	2491	11	126.0	0.06	0.11	0.11	27.54
Sapindaceae	727	19	12.7	0.09	0.03	0.01	13.24
Cunoniaceae	923	7	65.9	0.03	0.04	0.06	13.13
Myrtaceae	331	19	26.5	0.09	0.01	0.02	12.78
Atherospermataceae	1312	2	54.6	0.01	0.06	0.05	11.41
Rhamnaceae	909	3	30.3	0.01	0.04	0.03	8.00
Apocynaceae	486	6	22.2	0.03	0.02	0.02	6.90

N = number of individuals, Ni = number of species, BA = basal area (m^2), RDi = relative density, RF = relative frequency, RDo = relative dominance

Endemism and biogeography

Stems ≥ 10 cm dbh revealed 20 genera considered endemic to Australia and 11 genera endemic to the Wet Tropics. Endemism is principally at the species level; of the 208 species, 167 (80.3%) are endemic to Australia and 94 (45.2%) are endemic to the Wet Tropics bioregion. This is driven largely by species within the families Lauraceae, Myrtaceae, Proteaceae and Sapindaceae (Table 4).

The core 1-ha vascular plant survey revealed that 23 genera are endemic to Australia. Again, endemism is principally at the species level; of the 266 species, 203 (76.3%) are considered endemic to Australia and 110 (41.3%) are endemic to the Wet Tropics bioregion. Again, this is driven largely by species within the families Lauraceae, Myrtaceae, Proteaceae and Sapindaceae (Table 4). No species have a distribution restricted to the 25-ha plot and close surrounds, although of the Wet Tropic endemics present on the plot, 20 species (7.5%) are confined to the south of the Black Mountain Corridor (Rossetto et al. 2007). In this core 1 ha, 12.3% of the total Wet Tropics rainforest flora is represented and near-basal angiosperm lineages are well represented with 42 species or 24% of the total near-basal angiosperm rainforest flora of the Wet Tropics (Metcalfe & Ford 2009).

Table 4 The most speciose families from stems ≥ 10 cm dbh and the core 1 ha at the Robson Creek 25-ha plot, and the number of species in those families endemic to Australia and the Wet Tropic bioregion of Australia (WT)

Family	25-ha plot			Core 1 ha		
	Total species	Endemic to Australia	Endemic to WT	Total species	Endemic to Australia	Endemic to WT
Lauraceae	30	27 (90)	14 (47)	23	21 (91)	11 (48)
Myrtaceae	19	18 (95)	11 (58)	17	17 (100)	12 (70)
Sapindaceae	19	14 (74)	6 (32)	18	14 (78)	7 (39)
Proteaceae	14	14 (100)	13 (93)	9	9 (100)	9 (100)
Rutaceae	14	10 (71)	6 (43)	13	9 (69)	5 (38)
Elaeocarpaceae	11	10 (91)	4 (36)	9	8 (89)	2 (22)

Numbers in parentheses refer to the percentages of total species

Stand structure

Canopy species attained a maximum height of 44 m on the plot although values of 25 to 30 m were more common. The canopy was considered uneven and no emergent stems were identified. No species dominated the canopy although *L. leefeana*, *C. sublimis* and *F. bourjotiania* were most common. No species dominated the subcanopy although *Daphnandra repandula* (Atherspermataceae) and *Toechima erythrocarpum* (Sapindaceae) were most common.

The largest diameter tree on the plot attained 152.5 cm dbh (*Syzygium canicortex*, Myrtaceae). The frequency distribution of stem size classes for stems ≥ 10 cm dbh is shown in Figure 3. The stem density ≥ 10 cm dbh ranged from 714 to 1073 ha^{-1} (mean 936 ± 77 SD). The stem density ≥ 1 cm to < 10 cm dbh ranged from 9235 to 9417 ha^{-1} (mean 9326 ± 128 SD) in the 2 ha surveyed.

The survey of stems ≥ 1 cm and < 10 cm dbh revealed that 13.7% (± 1.9 SD) of the basal area was held in this size range. Incorporating this value, the mean basal area of stems ≥ 1 cm dbh in the 25 ha was 52.0 m^2 ha^{-1} (± 4.5 SD) and ranged from 45.5 to 62.6 m^2 ha^{-1}. For stems ≥ 10 cm dbh, the species *C. sublimis* (7.9%), *F. bourjotiana* (6.5%) and *L. leefeana* (5.5%) and the families Rutaceae (22.0%), Lauraceae (16.1%) and Proteaceae (15.5%) contributed the greatest basal area.

Aboveground biomass (AGB)

The survey of stems ≥ 1 cm and < 10 cm dbh revealed that 3.7% (± 0.3 SD) of AGB was held in this size range. Incorporating this value, the mean AGB of stems ≥ 1 cm dbh in the 25 ha was 418.5 Mg ha^{-1} (± 59.7 SD) and ranged from 306.3 to 561.5 Mg ha^{-1}. For stems ≥ 10 cm dbh, the species *F. bourjotiana* (6.7%), *C. sublimis* (6.5%) and *Flindersia pimenteliana* (6.0%) and the families Rutaceae (23.4%), Lauraceae (18.9%) and Proteaceae (14.9%) provided the greatest biomass. Figure 4 shows the distribution of basal area and AGB across the stem sizes.

DISCUSSION

The floristic and structural analysis of the Robson Creek 25-ha rainforest plot presented in this study reflects the unique traits of Australian Wet Tropical rainforests with high species endemism, affiliations with both Indo-Malayan and Gondwanan flora, and prevalence of tree species of the families Lauraceae, Myrtaceae, Sapindaceae and Proteaceae. In a summary of the Wet Tropic rainforest of Australia, Metcalfe and Ford (2008) report species endemism of 31.4% to the bioregion and 61.2% to Australia. Our plot values of 44.9% (bioregion) and 80.3% (Australia) for stems ≥ 10 cm dbh and 41.3% and 76.3% for vascular species on the core 1 ha are considerably higher, partly due to the dominance of the near-basal Lauraceae as well as the Myrtaceae and Proteaceae. High levels of speciation in these and other families are likely the result of historic persistence and later isolation of the Wet Tropical rainforests in Australia (Metcalfe & Ford 2008).

The rainforests of the Robson Creek 25-ha rainforest plot and in the Wet Tropics generally are structurally similar to the Indo-Malayan

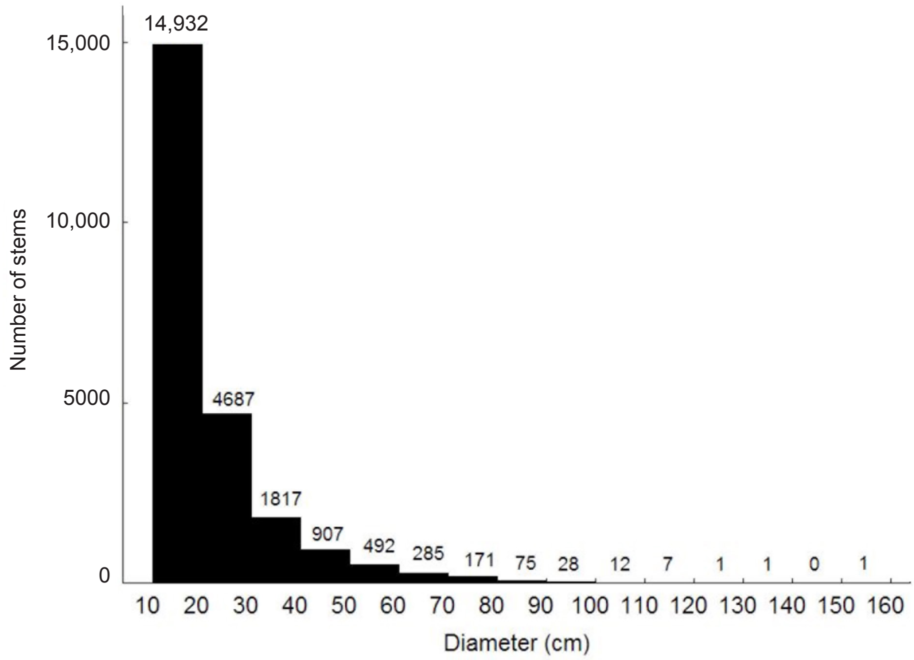

Figure 3 Frequency distribution of stems ≥ 10 cm dbh on the Robson Creek 25-ha rainforest plot; = numbers above bars denote actual stem numbers for each dbh size class

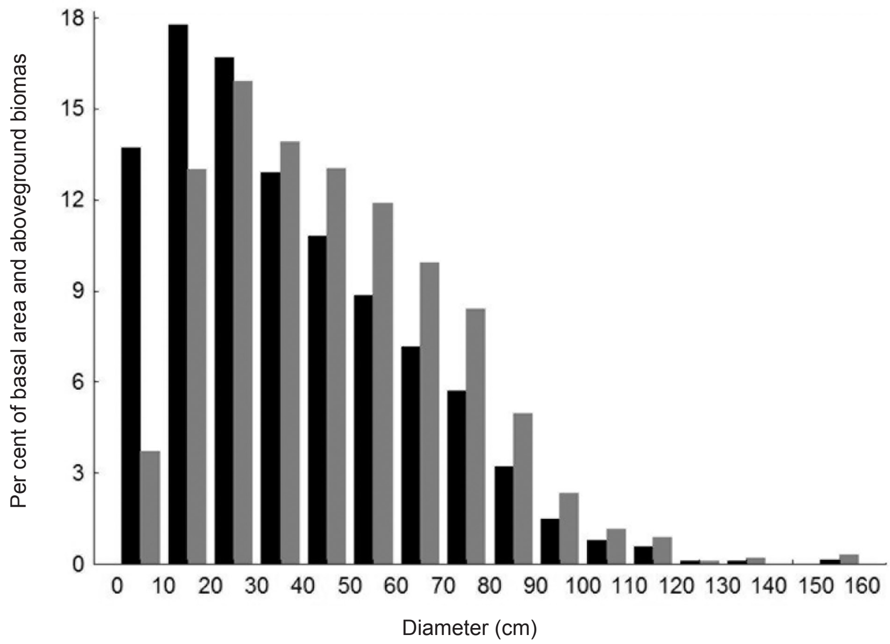

Figure 4 Frequency distribution of basal area (black fill) and aboveground biomass (grey fill) across stem size classes on the Robson Creek 25-ha rainforest plot

forests, especially those of New Guinea, with abundant climbing palms (*Calamus* spp.) (Richards 1996). If New Guinea is included in the Australian flora, species endemism rises to 91.8% for the trees ≥ 10 cm dbh and 85.3% for vascular plants on the core 1 ha. There is some overlap of families, genera and, rarely, species with forests in South-East Asia; the families Myrtaceae, Lauraceae, Sapindaceae along with Meliaceae are well represented in some South-East Asian forests (Sist & Saridan 1999, Lee et al. 2002, Co et al. 2006). The most notable absence from the Wet Tropics (and Australia) is the family Dipterocarpaceae. There is also considerable overlap with other regions which may be loosely termed Gondwanan, suggesting that ancestral taxa occurred on the super continent before its breakup and separation 55 million years ago (Coleman 1980). Families with Australian–Gondwanan origins presumably include Cunoniaceae, Elaeocarpaceae, Ericaceae, Monimiaceae (including Atherospermataceae), Proteaceae, Podocarpaceae, Araucariaceae and Winteraceae (Thorne 1986). These families, with the exception of Ericaceae, are all represented in the Robson Creek plot.

For the first time we report an estimate of aboveground living biomass for an Australian tropical rainforest derived from a comprehensive ground survey of a large area. Previous published values (Liddell et al. 2007, Preece et al. 2012) have been based on small plot sizes which may lead to unrepresentative estimates particularly if large trees are present. Our value of 418.5 Mg ha^{-1} is generally comparable with those for Indo-Malayan rainforests: 366–401 Mg ha^{-1} (Khairil et al. 2011), 271–478 Mg ha^{-1} (Laumonier et al. 2010) and 403 Mg ha^{-1} (Hoshizaki et al. 2004); and higher than forests in the Amazon basin: 125–387 Mg ha^{-1} (Baker et al. 2004).

Caution should be taken in assuming that our biomass value is representative of old growth forest in the Wet Tropics of Australia, as this tract of forest and extensive areas of similar forests in the region have been modified by logging during the 20th century. Although logging was seen as best practice at the time, it is considered a major driver of stand structure change of both this plot and Australian tropical rainforest in general. Values for extracted timber in the Wet Tropics (Crome et al. 1992) indicate that stem (6.6 trees ha^{-1}) and volume (37 m^3 ha^{-1}) losses were minimal. However, the incidental damage imposed on the forest, including 22% loss of canopy cover, was presumably enough to alter short-term growth and recruitment dynamics. On the Robson creek plot the large proportion of stems 10–20 cm dbh and the prominence of successional species such as *L. leefeana*, *C. sublimis* and *F. bourjotiana* more than 40 years after logging ceased are evidence of this. Whether the subsequent recruitment and growth of such species have recovered or even exceeded the biomass lost by extraction of timber and associated incidental loss is debatable and cannot be tested as there are no comparable large areas of unlogged forest. However, a 0.5-ha unlogged plot adjacent to the Robson Creek plot has an equivalent AGB of 700 Mg ha^{-1} (Murphy et al. 2013) which is considerably greater than values recorded on the 25-ha plot.

Recent severe disturbance events in Australian tropical rainforests are not restricted to anthropogenic drivers. Cyclones are particularly important structuring elements of rainforest in the Wet Tropics of Australia with historical data suggesting that a severe cyclone (categories 4–5) will cross a particular part of the coast of Australia about once every 75 years (Turton & Stork 2008). Severe cyclone Larry in 2006 caused moderate structural damage to the forest on and around the plot with a Bradford/Unwin damage score (Metcalfe et al. 2008) of 3 on the plot and the mortality of 74 trees ha^{-1} ≥10 cm dbh (Metcalfe et al. 2008, Murphy et al. 2013) on an adjacent CSIRO plot. Moreover, current aggregations on the plot of large *Blepharocarya involucrigera* (Anacardiaceae), a successional species, suggest at least one large disturbance event on a centurial time scale.

The Robson creek 25-ha rainforest plot was established to undertake intensive collection of ecosystem measurements to improve our understanding of environmental change. For the first time we present floristic and stand structure information for a large forested area in tropical Australia including taxa dominance, and an estimate of rainforest basal area and above-ground biomass. The future addition of a census of all stems to ≥ 1 cm dbh will give a complete picture of woody plant diversity and bring the Robson Creek plot into line with other large plots around the world. In addition, baseline data have been compiled for seedlings, vertebrates and invertebrates on the plot, with ancillary datasets monitoring soil and groundwater and a canopy flux tower collecting atmospheric flux data (http://www.tern-supersites.net.au/knb). Together this information will allow us to intensively monitor our ecosystem and detect environmental change, including that caused by human induced climate change. Australian rainforests are considered floristically diverse, are high in endemism, and their restricted distribution sees them particularly vulnerable to climate change and other anthropogenic influences. The Robson creek 25-ha rainforest plot is well placed to detect and monitor these changes and contribute to our understanding of global forest change.

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