

## **Black Mountain Symposium 2018 Background Paper No. 14**

### **Black Mountain plant collections and collectors, 1927–2017**

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**Abstract.** The history of plant collecting on Black Mountain was constructed from information contained on specimens held in the Australian National Herbarium. Over 4000 plant specimens have been collected from the area since the first in 1927 and represent the activity of at least 212 people. The majority of collections were made by staff from the herbaria at the Australian National Botanic Gardens and CSIRO, an outcome of these institutions' serendipitous location on the eastern foot-slopes of the mountain. The number of collections made each year is highly variable and accentuated by peak collecting periods related to the activity of 20 major collectors whose work appears to reflect their collecting interests and/or changing institutional priorities.

#### **1. Introduction**

This paper examines the history of plant collecting in the Black Mountain study area (as defined in Purdie 2018a) and covers Black Mountain Nature Reserve and the northern and southern annexes of the Australian National Botanic Gardens (ANBG). The history is based on plant specimens held in the Australian National Herbarium, many of which were originally part of separate herbaria at CSIRO and ANBG (see Appendix 1).

#### **2. Methods**

Data for all herbarium records with a collecting locality of “Black Mountain”, ACT were extracted from the Australian National Herbarium Specimen Information Register database (ANHSIR, <http://www.anbg.gov.au/cgi-bin/anhsir>) in December 2017. The data included collector, date of collection, location of the specimen, taxon group and taxon name for each plant record.

The dataset was ‘cleaned’ to remove specimens collected outside the defined Black Mountain study area (here-after just called the “study area”). Where the raw data showed two collectors with the same surname and similar initials, or possible spelling variations of a family name, the collection numbers and collection dates were cross-checked to determine whether or not they were the same person. Collecting dates that seemed incorrect (for example because of possible data entry errors in ANHSIR) were also checked, by matching the collecting number against the date of other collections in the same collecting number sequence and corrected as relevant. Comparable records were extracted from ANHSIR for the Mt Ainslie – Mt Majura area to provide a comparison of collecting effort with the study area.

For individuals with major collections from Black Mountain, their collections records for the ACT (excluding specimens of cultivated plants) were also extracted from ANHSIR to provide context to their local collecting activity. Anomalous collecting dates were cross checked with the collection numbers, dates or locations of other specimens of the same individual and corrected as necessary.

#### **3. Results**

##### **3.1 Number and density of collections**

The first herbarium record from the study area was a specimen of Red Box (*Eucalyptus polyanthemus*) collected in 1927. From then to the end of 2017, around 4037 herbarium specimens have been collected (Table 1) at a density of 8 specimens/hectare, or 13 times that for nearby Mt Ainslie – Mt Majura which covers twice the area (Table 2).

The number and proportion of collections and species for each plant type are shown in Table 1. The collections comprise 81% flowering plants (monocots and dicots), 9% lichens, 5% fungi, 3% mosses, 2% liverworts and <2% algae plus slime moulds, ferns and gymnosperms. Flowering plants are over-represented in the collections compared with their proportion of species (81% of specimens cf 67% of species). For all other groups of plants, the proportion of their specimens (<1–9% of the total) is lower than their proportion of all species (0.4–12%), i.e. they are under-represented in the collections.

**Table 1.** Number of plant specimens and species, 1927–2017

Plant type	Specimens		Species	
	Number	%	Number	%
Algae	4	0.1	4 <sup>a</sup>	0.4
Slime moulds	5	0.1	5 <sup>b</sup>	0.5
Macrofungi	182	4.5	125+ <sup>c</sup>	11.9
Lichens	341	8.5	114+ <sup>c</sup>	10.8
Liverworts & allies	81	2.0	24+ <sup>3</sup>	2.3
Mosses	120	3.0	50+ <sup>c</sup>	4.8
Ferns	49	1.2	19 <sup>d</sup>	1.8
Gymnosperms	6	0.1	4 <sup>d</sup>	0.4
Flowering plants	3249	80.5	705 <sup>d</sup>	67.1
<b>Total</b>	<b>4037</b>	<b>100</b>	<b>1050</b>	<b>100</b>

<sup>a</sup> Source: names in ANHSIR; the total may be lower when all the specimens are identified to species level.

<sup>b</sup> Source: Lepp (2018).

<sup>c</sup> Source: Purdie (2018b); numbers with a + sign indicate the total is probably higher, but herbarium specimens are yet to be identified to species level.

<sup>d</sup> Source: Purdie (2018a).

**Table 2.** Density of plant collections on Black Mountain and Mt Ainslie – Mt Majura

Place	Size (ha)	Number of specimens	No of specimens/ha
Black Mountain study area <sup>a</sup>	500	4037	8
Mt Ainslie <sup>b</sup>	640		
Mt Majura <sup>b</sup>	481		
Mt Ainslie + Mt Majura	1121	636	0.6

<sup>a</sup> Source: Purdie (2018a).

<sup>b</sup> Source: Find a Park (<http://www.environment.act.gov.au/parks-conservation/parks-and-reserves/find-a-park>, accessed 5/12/17).

### 3.2 Annual collecting activity

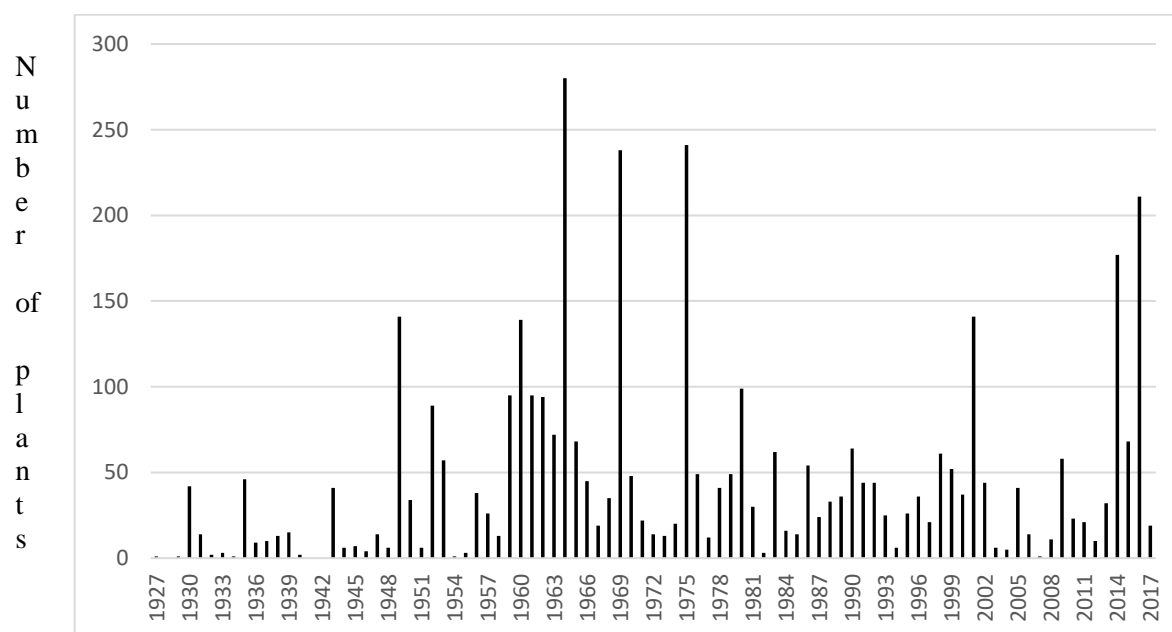
The number of plants collected in the study area each year since 1927 are shown in Fig. 1. The collecting effort is very variable over this period, with peaks of >100 specimens in 1949, 1960, 1964, 1969, 1975, 2001, 2014 and 2016, and 80–100 specimens in 1952, 1959, 1961, 1962 and 1980.

### 3.3 Collectors and institutions

At least 212 people have collected herbarium specimens from the study area since 1927 (Table 3). The actual number is slightly higher, as the name of the collector is missing from the herbarium labels of 29 specimens. Some 89% of the specimens have been collected by 53 people (25% of the collectors), each of whom has collected 10 or more specimens (Table 3); these collectors are listed in Appendix 2.

Twenty people have collected >40 specimens from the area, and 10 people >100 specimens (Appendix 2).

Of the 53 people with  $\geq 10$  herbarium specimens, staff from two institutions—ANBG and CSIRO—are responsible for 64% of the collections (40% and 24% respectively; Table 4). Most of the staff are associated with the herbaria (Appendix 2). This figure rises to 83% when the three collectors who are herbarium associates are included, and would increase slightly more if herbarium staff who have collected <10 plants in the area are considered. Seven of the 53 collectors are cryptogam specialists, and the remainder focussed solely or predominantly on vascular plants (Appendix 2), three of them mostly on orchids.



**Fig. 1.** Annual number of plant specimens collected, 1927–2017.

**Table 3.** Number of people who have collected specimens, 1927–2017

Number of collections	Collectors		Specimens	
	Number	%	Number	%
$\geq 10$	53	25	3600	89
<10	159	75	408	10
<10	Unknown	-	29	1
<b>Total</b>	<b>212+</b>	<b>100</b>	<b>4037</b>	<b>100</b>

### 3.4 Collectors over time

The major collectors in the study area (defined as people who have collected >40 specimens in total there), and their collections over five-year intervals, are shown in Table 5. The collectors are listed in historical order from left to right at the top of the table and discussed below under four main time periods that reflect key phases in the collecting history.

#### 1927–1954

A total of 565 specimens was collected in this 28-year period, with fewer than 50 plants collected each year except for 1949 (141 specimens), 1952 (89 specimens) and 1953 (57 specimens). The main collectors were W (William) Hartley, CWE (Ted) Moore and E (Erwin) Gauba (Table 5), who together accounted for 57% of the collections.

**Table 4.** Institutional home of collectors with  $\geq 10$  collections, 1927–2017

Institution	Collectors		Collections	
	Number	%	Number	%
ACT Parks & Conservation	3	5.7	66	1.8
Australian Forestry School <sup>a</sup>	2	3.8	28	0.8
ANBG	24	45.3	1426	39.6
Australian National University	2	3.8	134	3.7
CSIRO	16	30.2	875	24.3
Herbarium associates <sup>b</sup>	3	5.7	703	19.5
Sydney University	1	1.9	324	9.0
Nationaal Herbarium Nederland	1	1.9	16	0.4
Uncertain (Muller)	1	1.9	28	0.8
<b>Total</b>	<b>53</b>	<b>100</b>	<b>3600</b>	<b>100</b>

<sup>a</sup> The Australian Forestry School was established by the Commonwealth Government in September 1925 in Adelaide and transferred to Canberra in 1927; it was transferred to ANU in 1964 (Ling 2017).

<sup>b</sup> Individuals who work in a voluntary capacity as professionals in the herbaria located at ANBG and CSIRO.

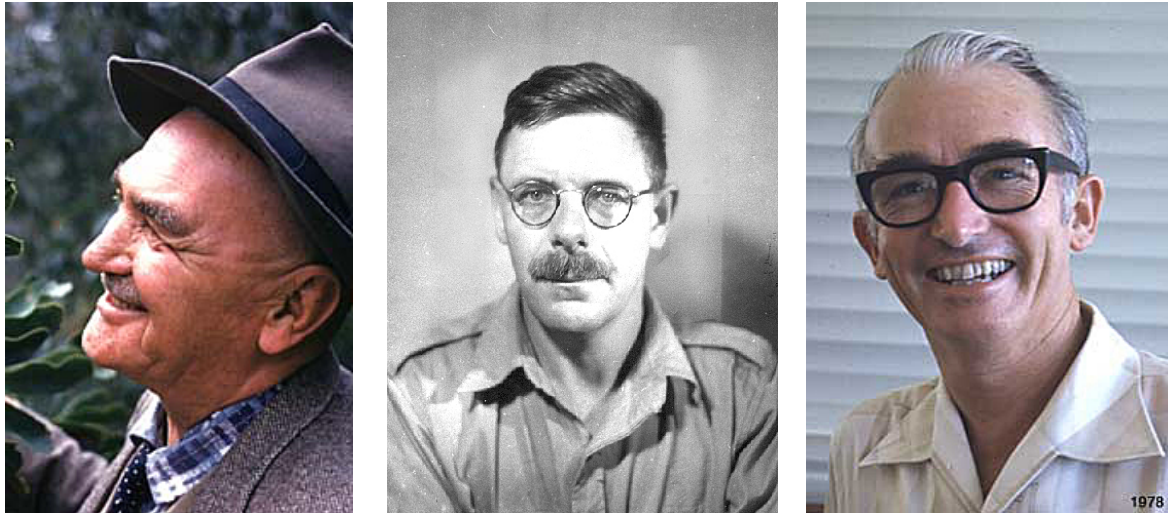
Hartley and Moore both worked at CSIRO. Hartley was a plant introduction officer in the Division of Plant Industry in the 1930s and 1940s (CHAH 2017a). In the ACT, he collected 176 specimens from 1929 to 1954, including 70 specimens from the study area (Table 5) from 1930 to 1953. Moore joined the CSIRO Division of Plant Industry in the early 1940s, initially working as an ecologist doing vegetation surveys in the south-eastern Riverina and western Division of NSW (CHAH 2015a). He was based in Canberra until shifting to Deniliquin in the late 1960s, returning to Canberra in 1973 upon his retirement (CHAH 2015a). In the ACT, he collected around 500 specimens in many parts of the territory from 1945 to 2003. He made 56 collections (Table 5) in the study area between 1945 and 1953.

Gauga was appointed a temporary botanist for the Commonwealth Government's Department of the Interior in 1950, where he became a close research associate of Dr Lindsay Pryor who supervised the early development of Canberra Botanic Gardens (CHAH 2015b, 2007). Until he left the Department in 1960 to join ANU, most of Gauba's work was for the Gardens (CHAH 2015b) and included extensive plant collecting, with his specimens later helping to form the basis of the Gardens' herbarium (Fagg 2017). Gauba collected at least<sup>1</sup> 900 specimens from across the ACT from 1942 to 1963, including 269 specimens from the study area (Table 5) from 1949 to 1954. While at the ANU, Gauba prepared a key to common tree and shrub species on Black Mountain, based on vegetative characteristics (Gauga undated).

### **1955–1969**

The total collecting effort of 1260 specimens in the 15-year period 1955–1969 was twice that of the previous 28 years, with the annual number of collections <50 specimens for half the years. Peak collecting years were 1959 (95 specimens), 1960 (139 specimens), 1961 (95 specimens), 1962 (94 specimens), 1964 (280 specimens) and 1969 (238 specimens). The major collectors were I (Irene) Beeton, M (Max) Gray, HS (Hugh) McKee, P (Pam) McDonnell and R (Roy) Pullen (Table 5), whose specimens accounted for 76% of all collections.

<sup>1</sup> An unknown number of Gauba specimens are held in the Gould Building, ANU.



**Fig. 2.** Erwin Gauba (left), Hugh McKee (centre) and Roy Pullen (right) made major plant collections from Black Mountain in the 1940s–1960s. Photos: from Australian Plant Collectors and Illustrators (<https://www.anbg.gov.au/bot-biog/index.html>).

Gray, McKee and Pullen were all associated with the CSIRO herbarium in the Division of Plant Industry. Gray joined the Division in 1950, initially based in Brisbane, and transferred to the herbarium in Canberra in 1955. He became a Senior Technical Officer in 1970 and worked on the taxonomy of Australian plants as well as co-authoring with Dr Nancy Burbidge (the head of the Herbarium) *The plants of the Australian Capital Territory*, published in 1963, and *Flora of the Australian Capital Territory*, published in 1970 (CHAH 2015c). Gray collected around 1250 specimens from across the ACT over the period 1955–1996; 145 of his 165 specimens from the study area (Table 5) were collected from 1955 to 1967. He co-authored the paper *A list of vascular plants occurring on Black Mountain and environs, Canberra, ACT* with Hugh McKee (see below) in 1969.

Pullen initially joined CSIRO in 1956 and worked as a botanical collector in Papua and New Guinea with the Division of Land Research and Regional Survey until 1972. He then transferred to the herbarium in the Division of Plant Industry until appointed CSIRO’s Plant Introduction and Quarantine Officer, probably around 1978–1980<sup>2</sup>. He retired from CSIRO in 1986 (CHAH 2015d). Pullen collected around 1530 specimens from across the ACT in the period 1953–1984. In the study area, he collected 295 specimens (Table 5), 231 of them in the period 1956–1969.

McKee was a botanist who joined the Botany Department at Sydney University in 1957 after working with the Queensland Agriculture Department, CSIRO and the South Pacific Commission (National Herbarium Nederland 2017). The University and CSIRO jointly appointed him a Senior Research Officer in plant physiology (Groves 2018). He made extensive plant collections in New Guinea and New Caledonia (National Herbarium Nederland 2017) and regularly visited the CSIRO Land Research and Regional Survey herbarium during the early 1960s to access its New Guinea collections (Schodde 2017). In the ACT, he collected about 500 specimens from 1960 to 1965, the majority of them (324; Table 5) from the study area during 1960–1964. He later co-authored the paper *A list of vascular plants occurring on Black Mountain and environs, Canberra, ACT* with Max Gray in 1969.

Beeton and McDonnell were both on the staff of Canberra Botanic Gardens in the 1960s and 1970s (CHAH 2014a; Fagg 2017). Beeton worked mainly in the library, prepared flower arrangements in the Gardens’ public display areas and was the main contributor to volumes 1–3 of the booklet *Growing Native Plants*, published from 1971, and one-page leaflets that preceded them in 1968 (CHAH 2014a). In the ACT, she collected around 245 specimens from 1961 to 1976, mostly within the Botanic Gardens and adjacent Black Mountain area. Beeton collected 81 specimens in the study area (Table 5) in the

<sup>2</sup> Based on his annual pattern of herbarium collections in ANHSIR, and the first references of his specimens being from the “Quarantine Glasshouse”.

period 1961–1969. McDonnell was a technician in the herbarium at the Gardens in the 1960s and 1970s (CHAH 2017b, Fagg 2017). In the ACT, she collected just over 200 specimens in the period 1965–1973, 183 of which were from the study area (Table 5) including 174 collected in 1969. The latter were most probably collected as part of the requirements for a TAFE course in horticulture (Fagg 2017).

### **1970–1989**

Fewer than 50 specimens per year were collected during 1970–1989 except for 1975 (241 specimens), 1980 (99 specimens), 1983 (62 specimens) and 1986 (54 specimens). The total number of collections over this period was 880 specimens. The major collectors were LG (Laurie) Adams, JA (Jack) Elix, B (Betty) Hain, J Hoare, Roy Pullen, H (Heinar) Streimann, JM (Joan) Taylor and D (Doug) Verdon (Table 5). Their combined specimens accounted for 60% of all collections.

Adams, Hoare and Pullen were employed at CSIRO. Pullen continued his collecting from the study area, although taking fewer specimens in 1970–1989 than in the earlier years (see 1955–1969 above and Table 5). Adams joined the Division of Land Research and Regional Survey in 1962 as a herbarium laboratory assistant. He remained in the Australian National Herbarium until his retirement in 1988 and continued to work there for a further 25 years as an Honorary Research Fellow (CHAH 2014b). In the ACT, Adams collected around 720 specimens in the period 1963–2007, including 44 from the study area (Table 5), about half of which were collected in the period 1971–1989. He authored the booklet *Trees and shrubs of Black Mountain, Mt Ainslie and Mt Majura: a key based on vegetative characteristics* in 1990. Hoare worked on fire ecology in the Division of Forest Research. He collected around 70 specimens in the ACT from 1969 to 1976, including 54 from the study area (Table 5), at least 22 of which were collected during 1970–1976.

Elix, appointed a lecturer in the Chemistry Department at ANU in 1967 where he worked until retirement in 2002, was also an internationally renowned lichen expert (Cohn 2017). On retirement, he became an Associate of the Australian National Herbarium where all his collections are located in the cryptogam collection housed at ANBG. In the ACT, Elix collected just over 2000 lichen specimens in the period 1965–2016, including 123 from the study area (Table 5), 96 of which were collected during 1974–1989.

Hain, Streimann, Taylor and Verdon were all staff at the Canberra Botanic Gardens herbarium. Verdon started work there in 1968 and remained with the herbarium until retiring in 1985. He developed a strong interest in lichens in the 1970s and continued working on their classification after retirement, in collaboration with Elix (CHAH 2015e). In the ACT, he collected just over 770 herbarium specimens (cryptogams and flowering plants) from 1963 to 1986, including 46 lichens and mosses from the study area (Table 5) in the period 1970–1979.

Streimann joined the Gardens in 1972 and collected cryptogams primarily as a private pastime until asked to establish a cryptogam herbarium in 1977 and appointed its Curator (Fagg 2017). He remained in that position until his retirement in 2000 (CHAH 2013). Streimann collected just over 3000 mostly cryptogam specimens from across the ACT. He collected 139 specimens of lichens, mosses and liverworts from the study area (Table 5) from 1977 to 1986 (90 of them just in 1980) and continued sporadic collecting there until 1993.

Hain and Taylor worked as technicians at the Gardens' herbarium (CHAH 2017a, 2017c), Hain in the 1970s and Taylor from c. 1975 (based on herbarium records) to 1991 when she retired (Taylor 2018). Their herbarium specimens from the ACT were mostly collected in the Canberra area, Hain's totalling 137 specimens during 1975–1976, and Taylor's totalling 154 specimens during 1975–1989. In the study area (Table 5), Hain collected 79 specimens in 1975, and Taylor 63 specimens in the same year and one in 1989. While Hain's collections were probably made as part of a TAFE horticulture course (Fagg 2017), Taylor's may have been to assist one of her children doing a major school assignment on the environmental impact of the Black Mountain telecommunications tower (Taylor 2018).

### **1990–2017**

Collecting over the 27 years from 1990 continued the pattern of the preceding decades, with <50 specimens collected annually for most years. A total of 1298 specimens was collected, with major peaks

**Table 5.** Major collectors from the Black Mountain area (>40 specimens in total) over time

Ada = Adams, LG; Bee = Beeton, I; Cle = Clements, MA; Cur = Curnow, JA; Eli = Elix, JA; Gau = Gauba, E; Gra = Gray, M; Hai = Hain, B; Har = Hartley, W; Hoa = Hoare, J; Jon = Jones, DL; Lep = Lepp, H; McK = McKee, HS; McD = McDonnell, P; Moo = Moore, CWE; Pul = Pullen, R; Pur = Purdie, RW; Str = Streimann, H; Tay = Taylor, JM; Ver = Verdon, D.

Years	Collectors and number of specimens																			
	Har	Moo	Gau	Pul	Gra	McK	Bee	Ada	McD	Hoa	Ver	Eli	Hai	Tay	Str	Cle	Jon	Cur	Lep	Pur
1927–29																				
1930–34	17																			
1935–39	5																			
1940–44	47																			
1945–49		23	134																	
1950–54	1	33	135																	
1955–59			7	119	37															
1960–64				101	67	324	69	7												
1965–69				11	41		12	8	175	21	3									
1970–74				19				2	8	16	6	7								
1975–79				43	16			2		6	40	76	79	63	3	8				
1980–84				2	1			1				12			123		1	13		
1985–89					3			16				1		1	13	4	23	6	9	
1990–94								2							15	9	18	9	35	
1995–99								1				1				10	25	12	23	
2000–04								5				22				3	87	8	55	
2005–09												4				1	8	1	6	59
2010–14																8				215
2015–17																				284
Total <sup>a</sup>	70	56	287	295	165	324	81	44	183	54	49	123	79	64	154	43	162	49	128	558

<sup>a</sup>The totals for Gauba and Hoare each includes 11 undated specimens.

in 2001 (141 specimens), 2014 (177 specimens) and 2016 (211 specimens), and smaller peaks in 1990 (64 specimens), 1998 (61 specimens) and 2015 (68 specimens). The major collectors were MA (Mark) Clements, JA (Judith) Curnow, DL (David) Jones, H (Heino) Lepp and RW (Rosemary) Purdie (Table 5), whose collections comprised 68% of the total. All were associated with the Australian National Herbarium through ANBG.

Jones joined the Gardens in 1987 and around a year later focussed his work on orchid taxonomy (CHAH 2011) until he retired in 2007 (Cross and Spencer 2011). He became known Australia-wide as an orchid authority and substantially increased the size of the herbarium's orchid collections (CHAH 2011). He collected around 690 orchid specimens from across the ACT in the period 1974–2006. His orchid specimens from the study area were collected during 1984–2006, most of them (138 specimens) from 1990 onwards (Table 5), with a peak collecting year of 87 specimens in 2001.

Clements joined the Gardens in early 1974, initially working as a gardener, then in the nursery and horticulture laboratory, becoming full time manager of the latter in 1977 and starting work on mycorrhizal associations in orchids (Clements 2017). Since then his research has spanned the biology, evolutionary relationships, nomenclature and conservation of orchids, and resulted in him receiving international acclaim (ANBG 2016). He collected about 400 orchid specimens in the period 1974–2012 from across the ACT. His 43 specimens from the study area (Table 5) were collected from 1975 to 2012 and include 31 specimens from 1990 onwards.

Curnow has been a technician at the ANBG herbarium since 1984 and has worked in its cryptogam collection since 1985 (Curnow 2017). In the ACT, she collected around 670 cryptogam specimens (mostly lichens, mosses and liverworts, but also some macrofungi and algae) from 1984 to 2017. In the study area, she collected 49 cryptogams during 1984–2005 (Table 5), about 60% of them in the period 1991–2005.

Lepp has been affiliated with the ANBG herbarium since 1985, including as an Associate of the Australian National Herbarium since 1993, working with the cryptogam collections (Lepp 2017). Although specialising in macrofungi and being Curator of the macrofungi collection, he has written websites on fungi, lichens and mosses for ANBG. He collected around 1370 macrofungi specimens from across the ACT in the period 1985–2015. His 128 specimens from the study area (Table 5) were collected from 1987 to 2009, the majority since 1990.

Purdie became an Associate of the Australian National Herbarium (through the ANBG) in 2002 after retiring from the Australian Public Service, largely working on her plant collections from various parts of Australia, and researching the flora of Black Mountain, Canberra since 2009. In the ACT from 1981 to 2017 she collected around 1335 specimens, mostly flowering plants, but also including liverworts and lichens. She collected 558 plants from the study area in the period 2006–2017, with major peaks in 2014 and 2016.

#### **4. Discussion**

A detailed history of plant collections on Black Mountain and the people who carried out the work is possible because of the information recorded on specimens contained in the Australian National Herbarium. The records show the number of specimens collected each year from the study area is highly variable and accentuated by peak collecting periods generally related to the collecting activity of a small number of individuals working for, or associated with, ANBG and CSIRO.

The high density of collections on Black Mountain (8 specimens/ha), and hence the detailed knowledge about its cryptogam and vascular flora (Purdie 2018a, 2018b), is predominantly the result of the ANBG and CSIRO herbaria serendipitously being located on the eastern foot-slopes of the mountain. Staff had easy access to the area and the professional interest to repeatedly collect there. Elliott and Douglas (1974) commented that “Many scientists at CSIRO have traditionally just hopped over the back fence to collect, not only insects but plant specimens and other animals”. The extent to which the plant collecting was carried out as part of specified duties, during lunch breaks or in the collectors' own time remains obscure.



Specimens of flowering plants in the study area greatly outnumber those of the other types of plants, and their over-representation in the collections (compared with their proportion of all species) most likely reflects the high number of people collecting them. The under-representation in the collections (compared with their proportion of the flora) of algae, slime moulds, macrofungi, lichens, liverworts, mosses, ferns and gymnosperms (conifers) probably relates to a combination of the small size of most individuals (many are easily overlooked), many species occurring only after suitable rainfall, fewer species being present in the area compared with flowering plants, and only a small number of people collecting them. Macrofungi are the most under-represented group in the collections (comprising 4.5% of specimens, compared with 12% of the flora). This probably reflects the fact that prior to the collecting activity of Lepp, an ANBG Associate who commenced in 1985, neither the ANBG nor CSIRO herbaria had a dedicated macrofungi expert on their staff.

It is probable that at least in the decades to the 1960s, much of the collecting was aimed at increasing scientific knowledge about the ACTs plants and helped underpin the accuracy of the first two detailed accounts of its flora: *The plants of the Australian Capital Territory* (Burbidge and Gray 1963) and *Flora of the Australian Capital Territory* (Burbidge and Gray 1970). The intensive collecting in the 1960s appears to have coincided with an increasing awareness of the conservation importance of Black Mountain after it was officially designated a “bushland reserve” in 1961 (Elliott and Douglas 1974) and facilitated publication of *A list of vascular plants occurring on Black Mountain and environs, Canberra, ACT* (Gray and McKee 1969) that also pushed for legal protection.

Compared with the previous 20 years, the number of plants collected from the study area dropped in the two decades after 1969, albeit with a major peak in collecting activity in 1975 and a lesser one in 1980. The 1975 peak was the result of the early cryptogam collections of Elix and the vascular plant collections of Hain and Taylor. The peak of activity in 1980 reflected Streimann’s cryptogam collecting, which built on that of Elix and, with the latter, greatly increased knowledge of Black Mountain’s lichens, mosses and liverworts. Proximity to Black Mountain was probably a major reason for the activity of all four collectors.

Plant collecting continued at low levels in most years from 1990 onwards. The peak in 2001 was associated with the collections of Jones, who was trying to relocate some elusive orchid records during conditions that provided “an exceptional orchid year” (Jones 2018). The 2014 and 2016 peaks were associated with the collecting activity of Purdie while searching for species not recorded on the mountain for 30 or more years (Purdie 2018a), a project spawned by the Gray and McKee (1969) publication.

## 5. Conclusion

Nine decades of plant collecting in the Black Mountain area by both professional and amateur botanists has provided a detailed knowledge of its plant diversity. The history of collections and major collectors there appears to reflect several phases in activity related to both herbarium priorities and the interests of a small number of individuals, from initial documentation of the vascular flora from the 1930s to the mid-1950s, to supporting nature conservation in the 1960s, to documenting the until-then-neglected cryptogam flora in the 1970s and 1980s.

Two of the major collectors in the 1960s—Max Gray and Hugh McKee—encapsulated the perceived importance of the Black Mountain area at that time in the introduction to their list of vascular plants (Gray and McKee 1969):

*The aesthetic, cultural, and recreational value of a natural forest area such as this in the centre of a city is so obvious that it should not need stressing; in addition, its scientific and educational value, situated as it is adjacent to the Australian National University, the CSIRO and the Canberra Botanic Gardens, makes it imperative that as much as possible of what remains of the area should be preserved as a Permanent Native Flora and Fauna Reserve.*

They continued:

*We hope that further studies of the natural history of the Black Mountain area will be undertaken by the many biologists resident in Canberra. In this way a very complete picture of the total ecosystem could be built up in the course of time, which, if collected and synthesised into a single volume, would be of great value to scientists, educationalists, and nature lovers alike in the community.* (Gray and McKee 1969, pp. 3, 5)

Gray and McKee's call for the general Black Mountain area to be preserved was largely achieved the following year when Black Mountain itself was formally declared a reserve (Elliott and Douglas 1974). Their hope for further natural history studies has also since been realised, as reflected in the number of plant collections in the area since 1969, outlined in this paper, and the body of other research carried out there (Purdie 2018c, 2018d), although most of the collections and research was probably due more to the close proximity of the herbaria and research institutions to Black Mountain than to Gray and McKee's publication.

## 6. Acknowledgements

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## 7. References

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### CSIRO and ANBG herbaria in Canberra

The following summary of changes in the names and institutional arrangements of the herbaria in CSIRO and ANBG provides the context for most of the major plant collectors in the Black Mountain study area.

Two herbaria were initially developed at CSIRO, one in the Division of Plant Industry, founded in 1928 (Lepschi 2017), and the other in the Division of Land Research and Regional Survey, founded c. 1952 and merged with the former between 1968 and 1973 (Hewson 2003; Lepschi 2017). This herbarium was named the Australian National Herbarium in 1984 (Hewson 2003).

The ANBG herbarium was established as part of Canberra Botanic Gardens, which was renamed the National Botanic Gardens on 21 December 1978 and the Australian National Botanic Gardens on 15 May 1984 (Fagg 2017).

Joint management arrangements for the CSIRO and ANBG herbaria were established in 1993 through the creation of the Centre for Plant Biodiversity Research, and the separate collections were amalgamated under the name Australian National Herbarium (Hewson 2003). The combined non-flowering plant collections (algae, fungi, lichens, liverworts, hornworts, mosses, ferns and gymnosperms) are located in the building at the ANBG site, and the combined flowering plant collections in the building at the CSIRO site.

## Appendix 2

### Individuals who have collected $\geq 10$ herbarium specimens from the Black Mountain area, 1927–2017

Table is based on data from the Australian National Herbarium Specimen Information Register database (ANHSIR), accessed December 2017. Because of the complicated history of the herbaria on Black Mountain (see Appendix 1), for those collectors working in the herbaria, their organisation has been simplified to just ANBG (Herbarium) or CSIRO (herbarium).

Name on herbarium specimens <sup>a</sup>	Collections and collecting period			Organisation	Type of plant
	Total No.	Year from	Year to		
Adams, LG	44	1963	2002	CSIRO (Herbarium) <sup>c</sup>	Vascular
Beeton, I	81	1961	1969	ANBG (Herbarium) <sup>c</sup>	Vascular
Burbidge, NT	18	1960	1967	CSIRO (Herbarium) <sup>c</sup>	Vascular
Calvert, J	26	1930	1932	CSIRO (Herbarium) <sup>c</sup>	Vascular
Campbell, TG	36	1935	1935	CSIRO (Division of Entomology) <sup>d</sup>	Vascular
Canning, E	13	1968	1988	ANBG (Herbarium) <sup>e</sup>	Vascular
Cargill, DC	16	2001	2001	ANBG (Herbarium) <sup>e</sup>	Cryptogams (liverworts)
Carter, CE	10	1930	1938	Australian Forestry School <sup>c</sup>	Vascular
Clements, MA	43	1975	2012	ANBG (Herbarium) <sup>e</sup>	Vascular (orchids)
Craven, LA	14	1974	1998	CSIRO (Herbarium) <sup>c</sup>	Vascular
Crawford, I	17	1995	2009	CSIRO (Herbarium Associate) <sup>e</sup>	Vascular
Crisp, MD	19	1975	2000	ANBG (Herbarium) <sup>e</sup>	Vascular
Curnow, JA	49	1984	2005	ANBG (Herbarium) <sup>e</sup>	Cryptogams
Darbyshire, PJ	23	1960	1963	CSIRO (Division of Land Research and Regional Survey) <sup>f</sup>	Vascular
Davies, F	20	1983	1983	ANBG (Herbarium) <sup>c</sup>	Vascular
Donaldson, S	17	1990	2004	ANBG (Living Collections) <sup>e</sup>	Vascular
Dunlop, CR	18	1966	1969	ANBG (Herbarium) <sup>c</sup>	Vascular
Elix, JA	123	1974	2009	ANU Dept Chemistry <sup>c</sup>	Cryptogams (lichens)
Fethers, S	28	2005	2012	ANBG (Living Collections) <sup>e</sup>	Vascular
FitzGerald, KJ	27	2002	2002	ANBG (Herbarium) <sup>g</sup>	Vascular (orchids)
Gaubas, E	287	1949	1956	ANBG (Herbarium) <sup>c</sup>	Vascular
Gray, M	165	1955	1988	CSIRO (Herbarium) <sup>c</sup>	Vascular
Groeneveld, KM	14	1986	1986	ANBG (Herbarium) <sup>c</sup>	Vascular
Hain, B	79	1975	1975	ANBG (Herbarium) <sup>c</sup>	Vascular

Name on herbarium specimens <sup>a</sup>	Collections and collecting period			Organisation	Type of plant
	Total No.	Year from	Year to		
Hartley, W	70	1930	1953	CSIRO (Division of Plant Industry; plant introductions) <sup>c</sup>	Vascular
Hoare, J	54	1969	1976	CSIRO (Division of Forest Research) <sup>f</sup>	Vascular
Hoogland, RD	16	1952	1972	CSIRO (Herbarium) <sup>c</sup>	Vascular
Ingwersen, F	13	1969	1970	ACT Parks & Conservation <sup>e</sup>	Vascular
Jones, DL	162	1984	2006	ANBG (Herbarium) <sup>c</sup>	Vascular (orchids)
Lepp, H	128	1987	2009	ANBG (Herbarium Associate) <sup>e</sup>	Cryptogams (fungi)
Lepschi, BJ	17	1990	2004	CSIRO and ANBG (Herbarium) <sup>f</sup>	Vascular
Mair, HKC	10	1931	1931	CSIRO (Division of Plant Industry; plant introductions) <sup>c, f</sup>	Vascular
Mallinson, DJ	31	1989	2009	ANBG (Herbarium) <sup>c</sup>	Vascular
McDonnell, P [MacDonnell]	183	1965	1970	ANBG (Herbarium) <sup>c</sup>	Vascular
McKee, HS [MacKee] <sup>b</sup>	324	1960	1964	Sydney University <sup>c</sup>	Vascular
Melvaine, A	19	1938	1962	CSIRO (Division of Plant Industry; plant introductions) <sup>f</sup>	Vascular
Millett, MRO [R]	18	1935	1937	Australian Forestry School <sup>c</sup>	Vascular
Moore, CWE	56	1945	1953	CSIRO (Division of Plant Industry, Ecology Section) <sup>c</sup>	Vascular
Muller, A	28	1966	1966	CSIRO?	Vascular
Mullins, E	32	1986	1986	ANBG (Education) <sup>c</sup>	Vascular
Ormay, P	20	1988	2012	ACT Parks & Conservation <sup>c</sup>	Vascular
Pirie, MD	16	2005	2005	Nationaal Herbarium Nederland <sup>f</sup>	Vascular
Pook, EW [E]	18	1963	1969	CSIRO (Division of Plant Industry, Ecology Section) <sup>f</sup>	Vascular
Pullen, R	295	1956	1983	CSIRO (Herbarium) <sup>c</sup>	Vascular
Purdie, RW	558	2006	2017	ANBG (Herbarium Associate) <sup>e</sup>	Vascular & some cryptogams
Streimann, H	154	1977	1993	ANBG (Herbarium) <sup>c</sup>	Cryptogams (mostly lichens)
Taylor, JM	64	1975	1989	ANBG (Herbarium) <sup>c</sup>	Vascular
Telford, IR	10	1989	1990	ANBG (Herbarium) <sup>c</sup>	Vascular

Name on herbarium specimens <sup>a</sup>	Collections and collecting period			Organisation	Type of plant
	Total No.	Year from	Year to		
Trappe, JM	11	1999	2000	CSIRO (Division of Wildlife & Ecology) <sup>h</sup>	Cryptogams (fungi)
Verdon, D	49	1969	1979	ANBG (Herbarium) <sup>c</sup>	Cryptogams (mostly lichens)
Walker, D	11	1963	1963	ANU <sup>i</sup>	Vascular
Ward, JE	33	1974	1995	ACT Parks & Conservation <sup>e</sup>	Vascular
Whalen, AJ	13	1998	1998	ANBG (Herbarium) <sup>e</sup>	Vascular

<sup>a</sup> Names or initials shown in square brackets are alternatives used on herbarium specimens for the same person; see Methods for further information.

<sup>b</sup> Both McKee and MacKee are correct spellings, see Foster and Conn (2013).

<sup>c</sup> Source: Australian plant collectors and illustrators, <http://www.anbg.gov.au/bot-biog/>, accessed December 2017.

<sup>d</sup> Source: K Pullen, Australian National Insect Collection, personal knowledge, December 2017.

<sup>e</sup> Source: RW Purdie, Australian National Herbarium, personal knowledge, December 2017.

<sup>f</sup> Source: BJ Lepschi, Australian National Herbarium, personal knowledge, December 2017.

<sup>g</sup> Source: MA Clements, Australian National Herbarium, personal knowledge, December 2017.

<sup>h</sup> Source: acknowledgements in Trappe et al. (2006).

<sup>i</sup> Source: deduced from herbarium specimen records in ANHSIR.