



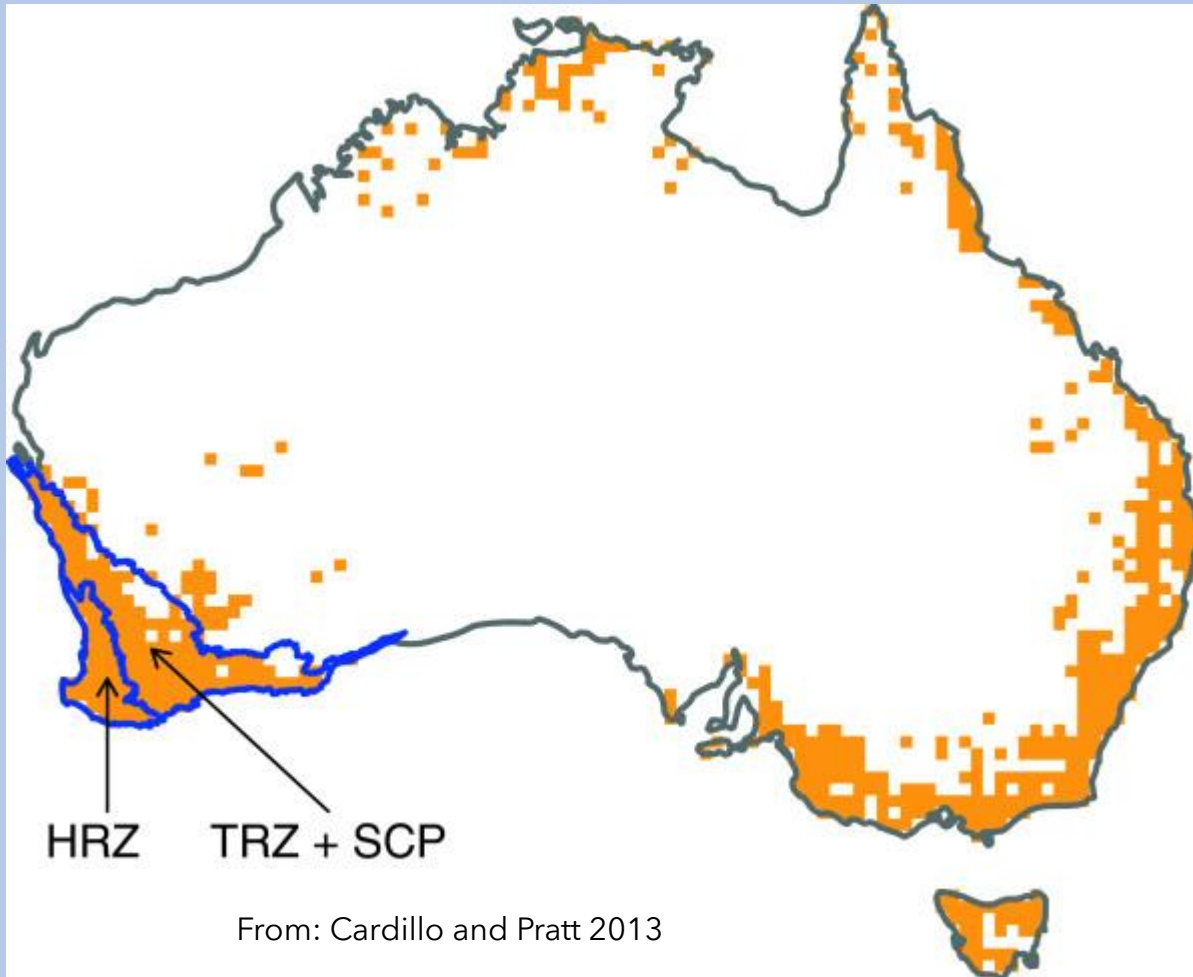
Banksia sessilis the forgotten
food

Will Stock, Teagan Johnston, Peter
Mawson, Hugh Finn, Leonie Valentine

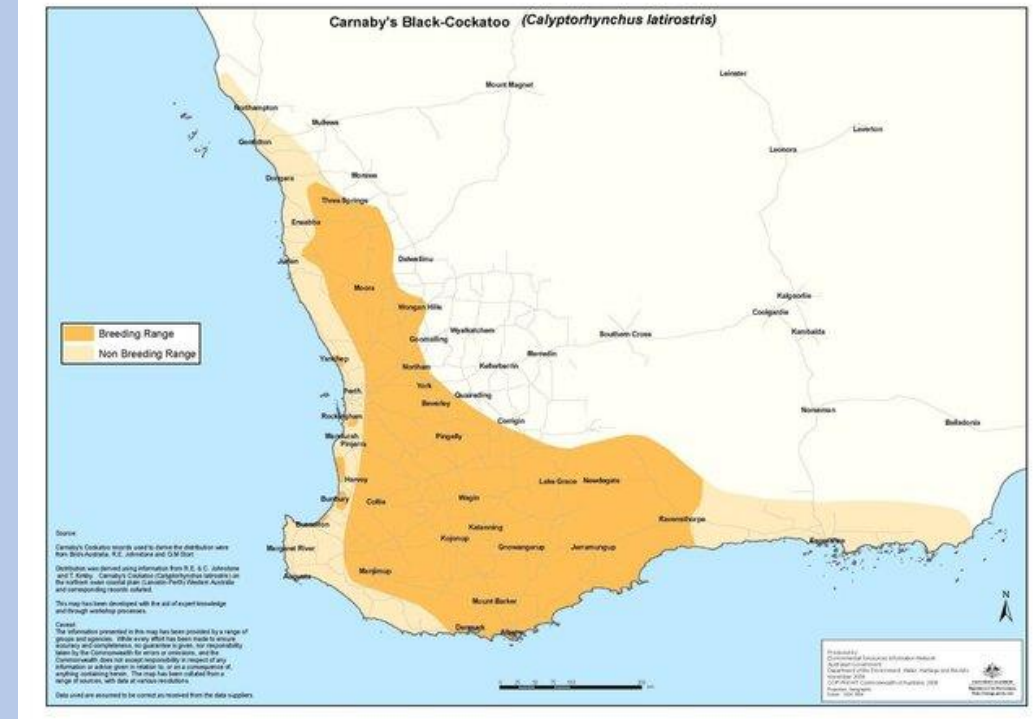
and many more

Distribution of *Banksia* in SW WA is same distribution as cockatoos.

Distribution of *Banksia* spp in Australia

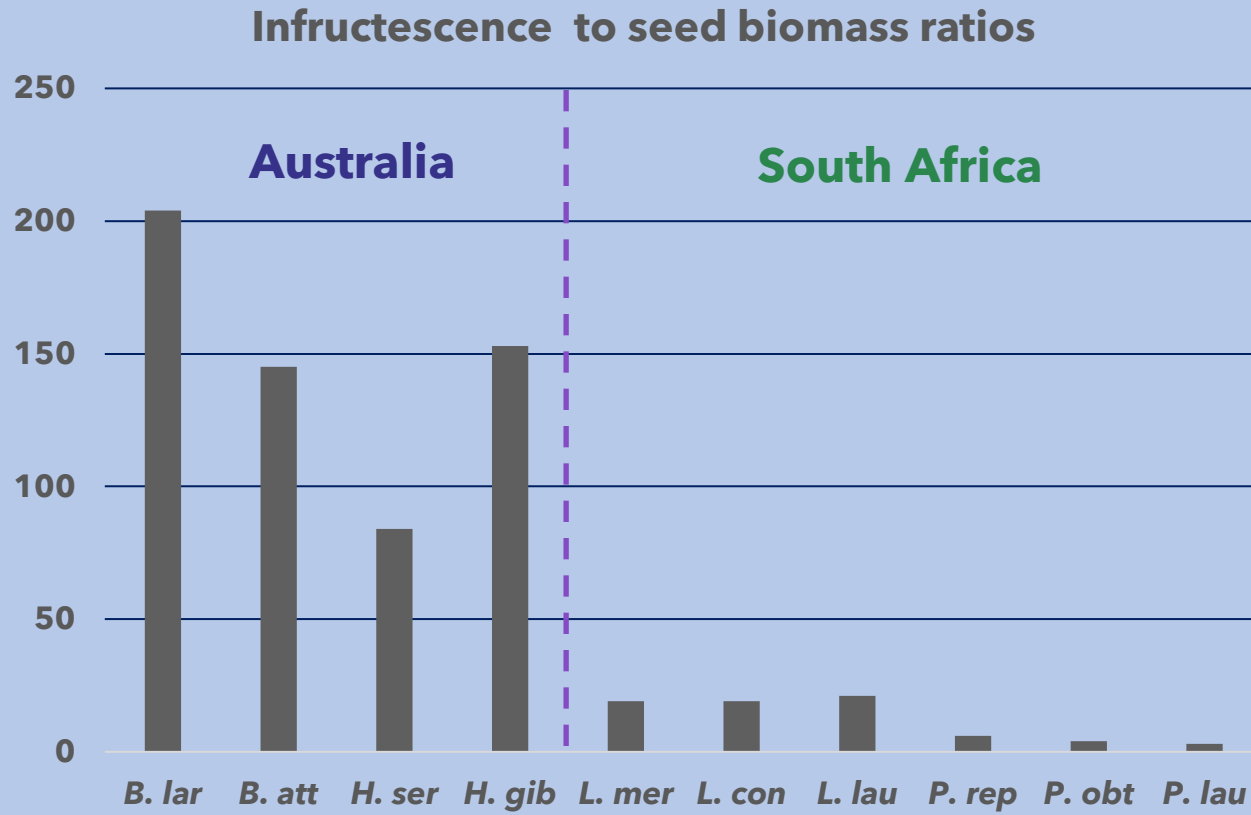


Distribution of Carnaby's Black-Cockatoo

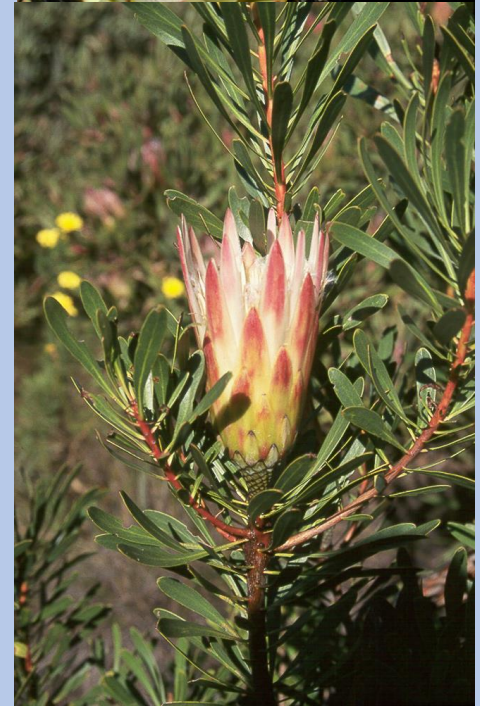


From: Groom 2010

Comparison of seed pod biomass with Proteaceae of South Africa shows huge difference. No need for mechanical protection in South Africa. No bird species of cockatoo size



Stock 1991





Locations of predominant activities Feed and Roost-Rest point samples by habitat type. Data from 42 flock follows from Feb-May 2009

Habitat Type	No. of point samples (%)	
	PDA: Feed (n = 145)	PDA: Roost-Rest (n = 156)
Pine plantation	66	55
Market garden	36	0
Homestead	5	41
Modified land	1	0
Banksia woodland	12	3
Tuart woodland	3	36
Other woodland	4	21
<i>B. sessilis</i> thicket	18	0

Research where CBC's spend time on SCP Feb to May. Much time eating and roosting in pine plantations. Peak pine seed availability yet Carnaby's still spend time on SCP. More time spent in *B. sessilis* than *Banksia* woodland.

Significant time roosting in Tuarts and other trees rather than feeding on them.

Proteaceae seeds have very high energy and nutritional values

Biggest differences is seed size ..compare *B. attenuata* with *B. sessilis*.

Although many *B. sessilis* seed required, they form thickets so can offer good food amounts.



Nutrition Information



Species	Seed Mass (g)	Cotyledon Mass (% Seed Mass)	Energy (J g ⁻¹)	Fat (%)	N (%)	Protein (%)	Seeds to Meet FMR (726 kj d ⁻¹)
<i>Acacia saligna</i>	0.0185	56	22 738	15.0	5.1	26.6	3 074
<i>Banksia attenuata</i>	0.1081	74	20 317	8.4	14.1	73.0	445
<i>Banksia grandis</i>	0.0764	81	20 425	11.0	14.6	75.6	576
<i>Banksia littoralis</i>	0.0214	73	20 583	8.9	14.6	75.6	2 270
<i>Banksia nobilis</i>	0.0188	76	22 245	12.8	13.8	71.4	2 272
<i>Banksia sessilis</i>*	0.0068	78	20 899	12.6	12.0	62.2	5 118
<i>Brassica napus</i>	0.0042	81	27 436	39.1	3.6	18.6	6 313
<i>Corymbia calophylla</i>	0.0985	59	24 052	26.3	7.1	36.6	523
<i>Eucalyptus marginata</i> *	0.0149	68	19 750	5.1	2.0	10.5	2 475
<i>Hakea incrassata</i>	0.0553	81	21 640	15.4	10.4	53.9	753
<i>Hakea laurina</i>	0.0222	75	24 254	25.6	10.1	52.3	1 801
<i>Hakea preisii</i>	0.0137	46	22 169	17.6	9.9	51.7	5 184
<i>Pinus pinaster</i>	0.0505	40	26 905	41.5	7.4	38.2	1 346
<i>Pinus pinea</i>	0.4774	9	24 766	32.2	6.3	32.5	657
<i>Xanthorrhoea preissii</i> *	0.0271	56	23 115	22.8	4.4	23.0	1 159

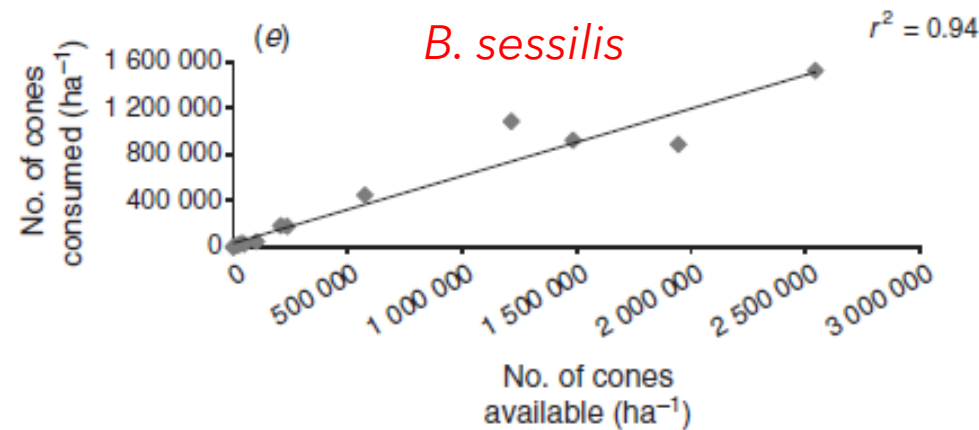
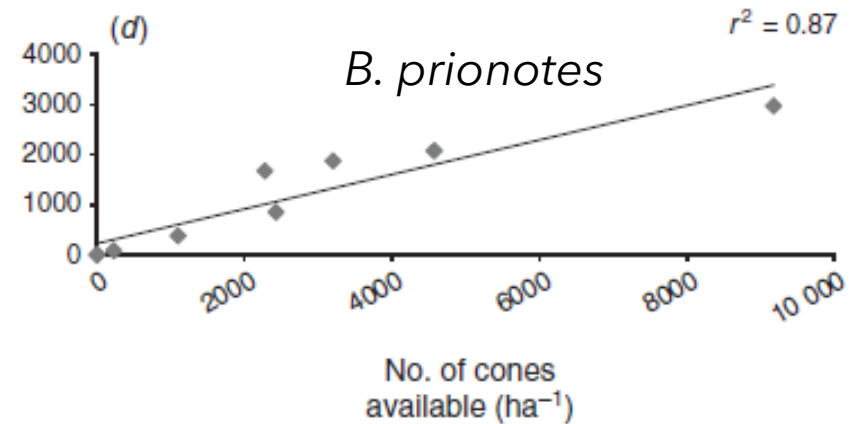
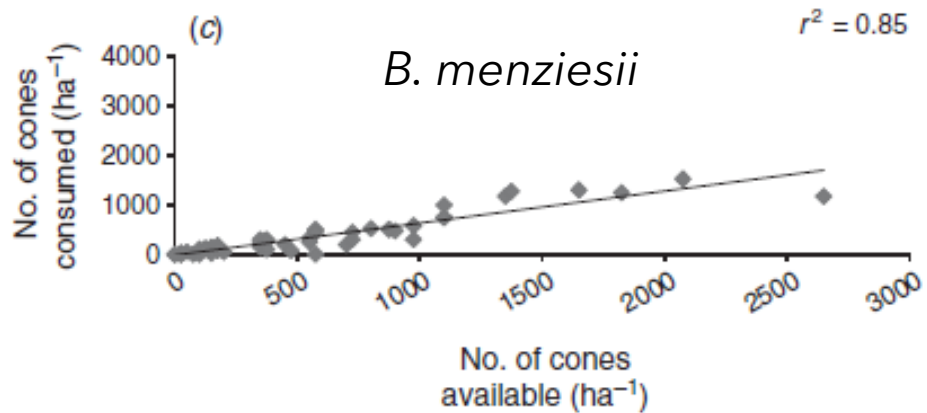
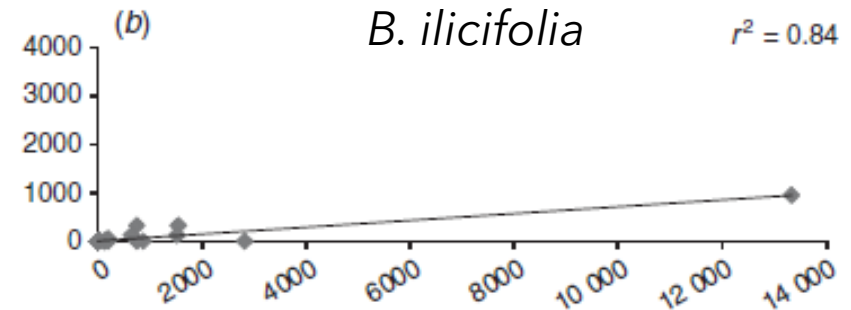
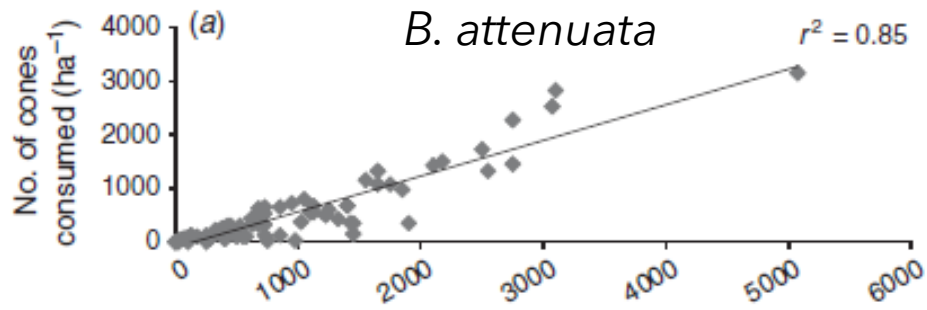
Field Metabolic
Rate from Cooper
et al. 2002

Stock et al. 2013

We had estimates for ideal situations but what was really happening in the field in terms of Banksia seed consumption

Table 2. Average number of *Banksia* cones available, handled and consumed (numbers per ha) by Carnaby's Black-Cockatoos over 12 months for six species of *Banksia*

	<i>B. attenuata</i>	<i>B. grandis</i>	<i>B. ilicifolia</i>	<i>B. menziesii</i>	<i>B. prionotes</i>	<i>B. sessilis</i>
Number of quadrats at which recorded (each 1200 m ²)	27	7	11	23	5	10
Number of reproductive stems (ha ⁻¹)	338	12	39	200	1 247	3 255
Number of cones available (ha ⁻¹)	990	14	6949	464	1 517	281 328
Number of cones handled (ha ⁻¹)	644	8	111	367	803	211 507
Number of cones consumed (ha ⁻¹)	513	7	58	290	648	178 971
% of available cones handled	65	58	16	62	53	75
% of available cones consumed	52	50	8	62	43	64
% of handled cones consumed	80	86	52	79	81	85
% of handled cones consumed for seed only	46	86	51	64	71	85
% of handled cones consumed for larvae only	22	0	1	9	5	0
% of handled cones consumed for both seed and larvae	12	0	0	7	4	0



At present close to all available food from Banksia species is being consumed which has implications for post-fire regeneration, No seeds = No Banksia woodlands



Banksia sessilis forms thickets



Outside of pine plantations these are some of largest flocks I have observed

Carnaby's cockatoos eat grubs and seeds. They may also feed on nectar.

Different species mature at different times of the year and grub feeding is usually out of sequence with seed maturation.

Time since last fire also determines how much food is available in the landscape.

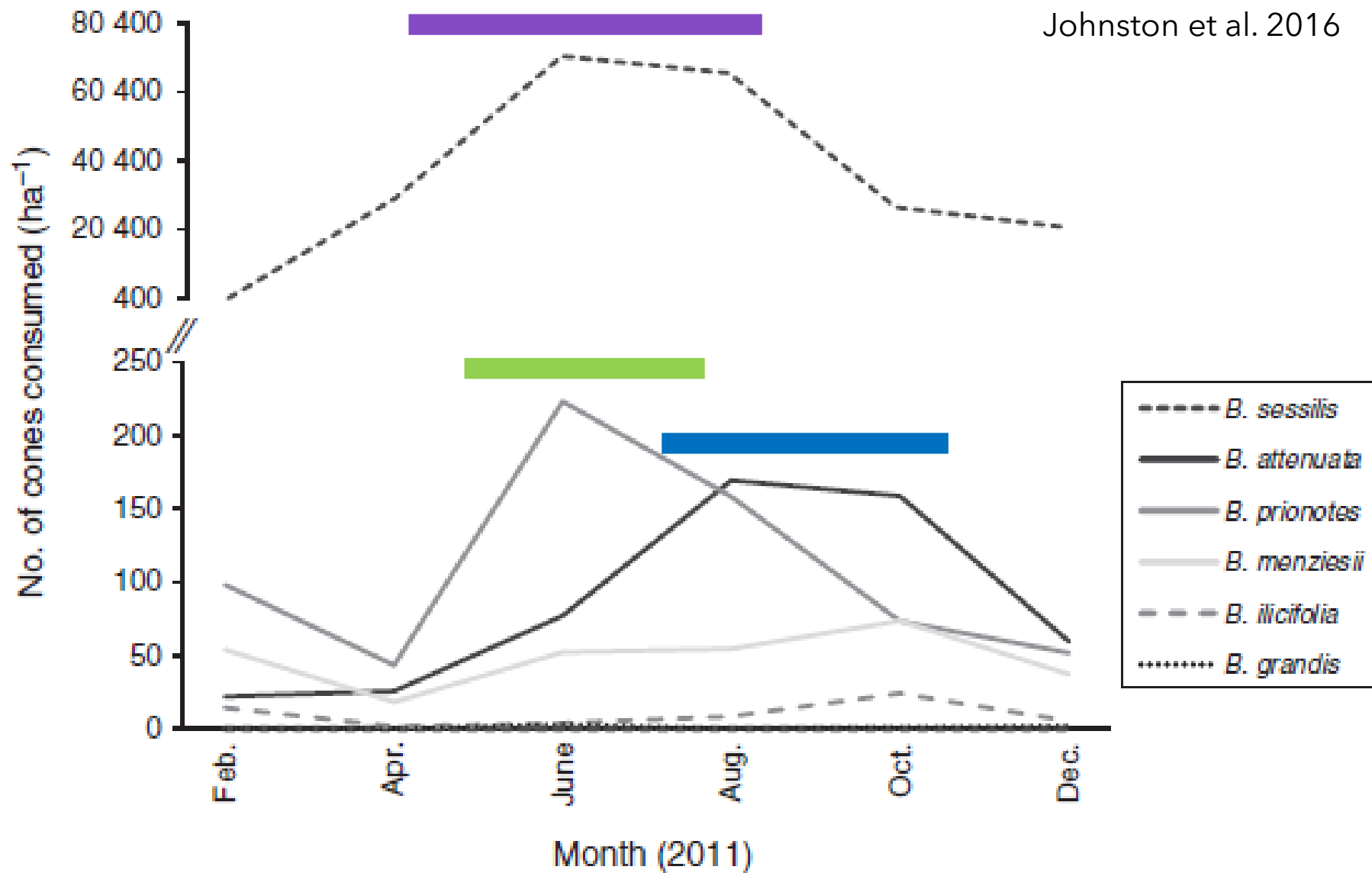


Fig. 3. Seasonal consumption of *Banksia* cones for seed or larvae, or both (numbers per ha) by Carnaby's Black-Cockatoos across the Swan Coastal Plain. Note the different scale for the number of cones consumed for *B. sessilis*.

Table 4. Mean number of *Banksia* cones and percentage of cones consumed by Carnaby's Black-Cockatoos in relation to time since last fire (TSLF)

Results from *post hoc* Tukey-b tests are shown for *B. attenuata* where fire histories with the same superscript letter (a, b, c) are not significantly different ($P > 0.05$).

Species	TSLF (years)	Number of quadrats (each 400 m ²)	Mean number of stems per ha ± s.e.	Mean number of cones per ha ± s.e.	Mean proportion of cones consumed ± s.e. (%)
<i>B. attenuata</i>	≤5	8	275 ± 52	288 ± 112 ^a	34 ± 0.1
	6–10	9	653 ± 184	578 ± 145 ^{a,b}	41 ± 0.1
	11–15	12	375 ± 45	1125 ± 226 ^b	58 ± 0.1
	16–20	8	355 ± 43	1963 ± 579 ^c	54 ± 0.1
	≥21	33	668 ± 114	1368 ± 256 ^c	56 ± 0.1
<i>B. menziesii</i>	≤5	5	240 ± 106	185 ± 103	15 ± 0.1
	6–10	3	468 ± 129	358 ± 209	51 ± 0.2
	11–15	9	365 ± 77	1310 ± 206	65 ± 0.1
	16–20	8	243 ± 74	725 ± 312	50 ± 0.1
	≥21	23	433 ± 88	453 ± 79	60 ± 0.1
<i>B. sessilis</i>	≤5	5	32 770 ± 18 693	325 ± 301	4 ± 0.0
	6–15	5	19 095 ± 8645	1 315 053 ± 454 533	57 ± 0.1
	≥16	7	240 ± 72	266 870 ± 161 677	78 ± 0.1

Can work out seeds required to meet daily metabolic rates of the Carnabys.

However little was know about actual use so two scenarios model Ideal vs Actual.

Species	Mean number of follicles per infructescence and number of follicles broken open by Carnaby's cockatoos for seed and insect larvae.		
	Follicles/ infructescence	Seed extracted	Larvae extracted
<i>B. attenuata</i>	11.6	2.6 (22%)	0.2 (0.02%)
<i>B. grandis</i>	56.3	29.1	0
<i>B. ilicifolia</i>	1.3	0.6 (43%)	0
<i>B. menziesii</i>	6.2	2.5 (40%)	0.1 (0.01%)
<i>B. prionotes</i>	26.6	7.0 (26%)	0.01 (<0.01%)
<i>B. sessilis</i>	1.2	0.7 (56%)	0

Mean number of follicles per infructescence and number of follicles broken open by Carnaby's cockatoos for seed and insect larvae.



Johnston et al. 2020

Number and percentage of banksia follicles that contained two, one or zero firm seeds.



Species	n follicles	Follicles with			Average n seeds per follicle (mean ± SE ⁻¹)
		2 seeds (%)	1 seed (%)	0 seeds (%)	
<i>B. attenuata</i>	916	45.7	35.7	18.6	1.27 ± 0.03
<i>B. grandis</i>	254	0	57.5	42.5	0.57 ± 0.03
<i>B. ilicifolia</i>	99	33.3	41.4	25.2	1.08 ± 0.08
<i>B. menziesii</i>	387	39.0	31.0	30.0	1.09 ± 0.04
<i>B. prionotes</i>	389	18.0	11.6	70.4	0.47 ± 0.04
<i>B. sessilis</i>	206	44.7	28.2	27.2	1.17 ± 0.06



Seed weight, energy, and number required to meet Carnaby's cockatoo field metabolic requirements

Scenario 1 -Ideal

Mean number of follicles per infructescence, two seeds per follicle, all consumed by Carnaby's cockatoo

Scenario 2 – More probable

Mean number of follicles with seed extracted by Carnaby's cockatoo per infructescence using estimated number of firm seeds

Johnston et al. 2020

	Mean seed weight (g ± SE)	Seed energy content (kJ g ⁻¹)	<i>n</i> seeds to meet FMR (726 kJ d ⁻¹)	<i>n</i> infructescences d ⁻¹	<i>n</i> infructescences d ⁻¹
<i>B. attenuata</i>	0.075 ± 0.0036	20.32	476	21	147
<i>B. grandis</i>	0.045 ± 0.0023	20.43	790	7	47
<i>B. ilicifolia</i>	0.037 ± 0.0026	21.36	919	342	1 351
<i>B. menziesii</i>	0.053 ± 0.0014	22.27	615	50	225
<i>B. prionotes</i>	0.019 ± 0.0003	22.91	1 668	31	508
<i>B. sessilis</i>	0.007 ± 0.0005	20.90	4 962	2 121	6 525


If we are spending money on offsets which is most effective?

	Energy Density	Ratio	Refs	Assumptions
	kJ/ha			
<i>Banksia attenuata</i> woodland	50000	1	Johnson MSc	1500 infruct/ha = good habitat
<i>Pinus pinaster</i> plantation	200000	4	Stock et al. 2013	Based on Gnangara pine data
Macadamia Orchard	39130000	783	Estimated	Based on 100 trees/ha, yield 13 kg/tree, 30kJ/g
Pecan Orchard	52920000	1058	Estimated	Based on 100 trees/ha, yield 18 kg/tree, 29kJ/g
Almond Orchard	35000000	700	Estimated	Based on 100 trees/ha, yield 18 kg/tree, 25kJ/g

To get 50000 kj h⁻¹ we need 1500 *Banksia attenuata* or 252106 *Banksia sessilis* infructescences

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A black and white cockatoo is perched on a green tree branch. The bird has a large white beak and is looking to the left. A purple thought bubble is positioned above the bird's head, containing the text "Just leave me some tucker mate". The background is a clear blue sky.

Just leave
me some
tucker mate



Alternative food like canola has proven to cause paralysis (Kris Warren research at Murdoch Uni)