Arthropods on street trees: a food resource for wildlife

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INTRODUCTION

As with most cities throughout the world, the Western Australian city of Perth is beautified with rows of street trees. Here, the choice of trees tends to be dictated by their hardiness and ease of cultivation (e.g., Queensland Box *Lophostemon confertus*), their perceived beauty (e.g., Lemon Scented Gum *Eucalyptus citriodora*) and the affiliation with species from regions where many of the settlers originated (e.g., London Plane Tree *Platanus acerifolia*). Evidence indicates that the abundance and diversity of arthropods on a tree species is, to a large extent, a reflection of the tree in recent geological history — the more recent the arrival, the less arthropods are likely to occur on it (Southwood 1960, 1961). From work with native eucalypt species, Recher *et al.* (1996) have found that arthropod density and diversity differs markedly between tree species within an ecosystem, and this phenomenon flows through to the insectivorous birds which forage on these trees. Those species with high levels of arthropods, such as Narrow-leaved Ironbark *E. crebra* in New South Wales are visited by pardalotes, thornbills and weebills to a much greater extent than the co-dominant Grey Box *E. moluccana* (Recher *et al.* 1994).

The planting of trees in cities can contribute to the conservation of arthropod diversity. This can also encourage insectivorous vertebrates (Majer and Recher 1994) and provide means for such animals to move through the urban matrix, thus meeting one of the objectives of the Perth Bushplan (Western Australian Planning Commission 1998) and the associated Perth Greenway Project (Alan Tingay and Associates 1998). However, if trees do not support sufficient levels of arthropods, their utility for providing food for wildlife is severely limited. The question therefore arises as to whether the trees being planted support an abundant and varied arthropod fauna, and whether, as Southwood suggests, exotic species are less rich in arthropods than species originating on the Swan Coastal Plain where Perth is located.

The campus of Curtin University in Perth provides an opportunity to investigate whether this is likely to be a problem, since its roads and paths are fringed with examples of local *Eucalyptus* spp., non-local *Eucalyptus* spp. and exotic trees. In April 1999, we conducted a pilot investigation of this using the same arboreal arthropod sampling techniques that Recher *et al.* (1996) used for sampling forest trees. We sampled local Marri *E. calophylla*, Bald Island Marlock *E. conferruminata* from the south coast of Western Australia, Tipuana *Tipuana tipu* from South America, and Camphor Laurel *Cinnamomum camphora*, an Oriental species. Although the *E. calophylla* trees were native to the area, all specimens that we sampled had been planted on the campus; *E. conferruminata* does not occur in the Perth region.

Five trees of each species, ranging from 5 to 10 m high and scattered along roads and paths throughout the campus, were selected for sampling. Trees were situated about 15 m away from the nearest tree, which was usually a specimen of the same tree species. Each tree was sampled by placing five 0.5 m^2 circular nets within the lower part of the crown. Trees were then sprayed with a pyrethrin pesticide. After allowing 60 minutes for animals to die, the foliage was shaken to dislodge remaining animals and the nets were emptied. The arthropod catch was stored in 70% ethanol and then sorted to ordinal level. The material from the five nets from each tree was bulked to produce one sample per tree. Since the data can be regarded as samples from a Poisson distribution, the tree counts were transformed by taking the square root in order to stabilize variances. The total arthropods per order was then compared between tree species using one-way analysis of variance and those means which differed from each other were ascertained using the Fisher *post hoc* test. The abundance of arthropods within each separate order was ranked and the overall ranking of these values was compared using Kendall's coefficient of concordance.

RESULTS AND DISCUSSION

The mean numbers of arthropods per order and the overall totals for each tree species are shown in Table 1. Marri supported the greatest number of arthropods, followed by Bald Island

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Table 1. Mean numbers of arthropods per tree, sampled during April 1999 by chemical knockdown. Numbers of arthropods were obtained by summing specimens from five nets. Means (± se) for each species were compared using univariate analysis of variance (ANOVA) and those that are significantly different are indicated in bold. Means annotated by the same letter indicate that they are not significantly different from each other (F critical value = 2.1 at α = 0.05).

Species			*E. calophylla*	*E. conferruminata*	*T. tipu*	*C. camphora*	Tree comparison	
Class	Taxon		n = 5	n = 5	n = 5	n = 5	F	P
Arachnida	**Acarina**		**112.8 ± 62.2^{a}**	**44.2 ± 15.5^{ab}**	**20.0 ± 8.9^{ab}**	**4.8 ± 1.3^{b}**	**3.3**	**<0.05**
	Araneae		**13.2 ± 7.6^{ab}**	**25.4 ± 5.3^{a}**	**6.4 ± 2.1^{b}**	**2.8 ± 1.1^{b}**	**4.7**	**<0.05**
Collembola			0.4 ± 0.4^{a}	0.0 ± 0.0^{a}	6.8 ± 3.4^{a}	5.8 ± 5.3^{a}		NS
Insecta	**Blattodea**		**5.2 ± 1.8^{a}**	**17.2 ± 5.4^{b}**	**0.4 ± 0.3^{c}**	**0.0 ± 0.0^{c}**	**20.5**	**<0.05**
	Orthoptera		**0.0 ± 0.0^{a}**	**3.2 ± 2.0^{b}**	**0.0 ± 0.0^{a}**	**0.0 ± 0.0^{a}**	**7.05**	**<0.05**
	Pscocoptera		**26.8 ± 11.7^{a}**	**38.2 ± 8.4^{a}**	**5.6 ± 1.1^{b}**	**1.4 ± 0.8^{b}**	**10.6**	**<0.05**
	Hemiptera	**Homoptera**	**98.2 ± 52.4^{a}**	**139.2 ± 44.7^{b}**	**25.0 ± 20.6^{ac}**	**0.6 ± 0.4^{c}**	**8.0**	**<0.05**
		Heteroptera	**38.0 ± 14.6^{a}**	**18.0 ± 3.5^{a}**	**1.6 ± 0.7^{b}**	**0.0 ± 0.0^{b}**	**16.8**	**<0.05**
	Thysanoptera		**52.0 ± 26.1^{a}**	**30.8 ± 5.9^{a}**	**4.2 ± 1.4^{b}**	**3.8 ± 1.8^{b}**	**7.94**	**<0.05**
	Neuroptera		1.6 ± 1.4^{a}	1.0 ± 0.5^{a}	0.0 ± 0.0^{a}	0.2 ± 0.2^{a}		NS
	Coleoptera		**30.2 ± 7.3^{a}**	**15.4 ± 2.5^{b}**	**3.8 ± 1.4^{c}**	**1.2 ± 0.8^{c}**	**22.3**	**<0.05**
	Diptera		24.8 ± 13.4^{a}	11.0 ± 0.8^{a}	5.4 ± 1.6^{a}	3.4 ± 0.7^{a}		NS
	Lepidoptera		**2.2 ± 2.0^{ab}**	**2.0 ± 0.6^{a}**	**0.0 ± 0.0^{b}**	**0.0 ± 0.0^{b}**	**4.4**	**<0.05**
	Hymenoptera	**Ants**	**16.2 ± 7.7^{a}**	**13.6 ± 1.9^{a}**	**29.2 ± 20.3^{a}**	**0.4 ± 0.4^{b}**	**4.3**	**<0.05**
		Others	**30.8 ± 16.2^{a}**	**24.2 ± 2.4^{a}**	**8.8 ± 0.6^{ab}**	**5.0 ± 2.3^{b}**	**4.2**	**<0.05**
Total Arthropods			452.4	383.4	117.2	29.4		
Best rank (All taxa)			1	2	3	4		

Marlock, Tipuana and, finally, Camphor Laurel. This ranking was maintained when the overall rank was calculated, which was significant at $P < 0.01$ (Kendall's Coefficient $W = 0.54$). The joint ranking of the two *Eucalyptus* spp. in relation to Tipuana and, in turn, to Camphor Laurel was principally responsible for the strength of this relationship; almost as many orders ranked first on *E. conferruminata* as on *E. calophylla.*

Twelve of the taxa exhibited statistically significant differences between tree species. In all of these cases, except for ants, there was no significant difference between Tipuana and Camphor Laurel, and only three significant differences (Blattodea, Orthoptera and Coleoptera) between *E. calophylla* and *E. conferruminata*; the main differences lay between *Eucalyptus* and the exotic tree species.

The findings confirm Southwood's (1960, 1961) prediction that species with a long history of residence in a region are likely to support the greatest variety of arthropods. This relationship may well extend to differences within the genus *Eucalyptus,* although the trend of fewer arthropods on non-local *E. conferruminata,* than on *E. calophylla,* is not great. Similar samples taken elsewhere in Perth indicate that the eastern Australian eucalypts, Sugar Gum *E. cladocalyx* and Southern Mahogany *E. botryoides*, sometimes support as many canopy arthropods as the local Jarrah *E. marginata* and Tuart *E. gomphocephala,* a trend that seems to be related to the high foliage nutrient levels in the two eastern species (Radho-Toly 1999).

The current results highlight the value of planting *Eucalyptus*, preferably local ones, as opposed to exotic tree species, for encouraging canopy arthropods in Australian cities. Probably it is best to plant eucalypts from Western Australia if talking about Perth and eastern species in, say, Sydney or Melbourne. This, in turn, would provide food resources for native birds, thus encouraging them to frequent roadside trees and/or use them to move between larger patches of vegetation. There are cases where wildlife can use exotics, such as the taking of nectar from some of the large, showy flowers of certain introduced species; this may be the case with the large, yellow flowers of Tipuana. However, our observations suggest that canopies of the two introduced tree species at Curtin University are seldom visited by birds, while insectivorous species abound in the eucalypts.

Planting of local tree species provides an opportunity for contributing to the conservation of animals that formerly occupied the large tracts of land that have been urbanized. It remains to be seen whether this is the case in other countries throughout the Pacific region, although Southwood's (1960, 1961) findings suggest that this would be the case. Quantification of arthropod levels on trees is relatively easy to perform, making this sort of investigation an ideal student exercise. Hopefully, as more studies like this are carried out, we will be able to draw up ecologically sound guidelines for greening our cities.

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