For *Thylogale thetis* (*T. thetis*) and *Thylogale stigmatica* (*T. stigmatica*) at the Dorrigo study site, the Levin's standardised niche breadths were calculated as 0.528 and 0.706, respectively. This measure reflects the degree of specialisation of a species with respect to resource states. In the case of dietary niche breadth, a lower score indicates a narrower niche breadth and higher degree of specialisation [1]~~(Krebs, 1989)~~. By this index, *T. stigmatica* has a wider niche breadth than *T. the*~~*ts*~~*is*. From the stomach content~~s~~ samples collected, *T. thetis*'s diet was observed to be dominated by four plant species, while *T. stigmatica*'s consumption was more evenly distributed, with six species contributing more than 10% of the total (see Table ~~1)~~I).

~~Table~~ TABLE I~~1~~

~~.~~COMPOSITION OF THE DIETS OF *T. THETIS* AND *T. STIGMATICA*~~, BY PERCENTAGE~~

Food resource	***T. thetis***	***T. stigmatica***
Trifolium (red leaf clover, leaf)	**15.60%**	–
Poa (snow grass, leaf)	**16.00%**	–
Pennisetum (kikuyu grass, leaf)	**17.20%**	–
Paspalum (water grass, leaf)	**26.20%**	–
Solanum (native tobacco, leaf)	5.00%	7.51%
Cissus (jungle grape, leaf)	1.80%	**10.14%**
Ozothamnus (native daisy, leaf)	5.40%	3.25%
Smilax (barbwire vine, leaf)	2.40%	**11.97%**
Ficus (native fig, fruit)	5.80%	**20.49%**
Tasmania (pepper bush, fruit)	1.00%	**17.85%**
Cyathea (tree fern, leaf)	–	**11.16%**
Asplenium (bird nest fern, leaf)	–	1.01%
Alphitonia (native ash, seed)	3.60%	**14.60%**
Dendocnides (stinging tree, leaf)	–	2.03%

Further, when grouping by pasture leaf, forest leaf, fruit or seed (see Fig.~~ure~~ 1), *T. thetis*'s diet overwhelmingly ~~comprised~~ consisted of pasture grasses, while *T. stigmatica's* diet included large components of forest leaf and fruit, further demonstrating its wider dietary niche.

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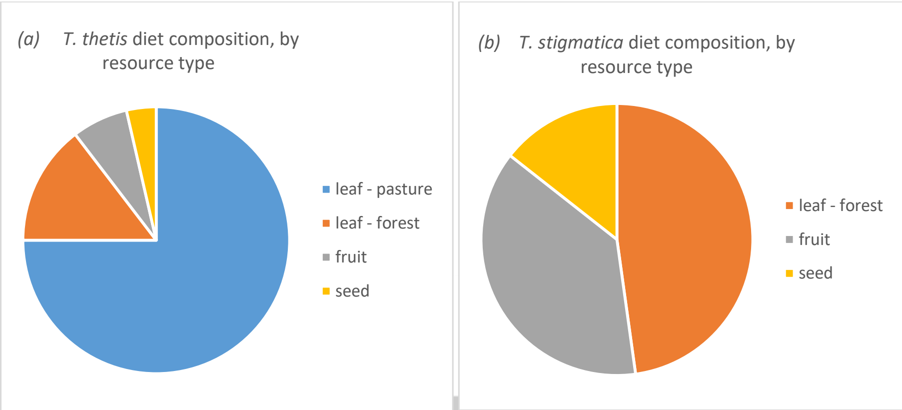

~~Figure~~ Fig. 1. Comparison of the composition of the diets of *T. stigmatica* and *T. thetis* by resource type: P~~p~~asture or forest browse (forest leaf, fruit and seed).

These findings are supported by previous observations for communities in which *T. thetis* and *T. stigmatica* were sympatric [2] ~~(Jarman & Phillips, 1989)~~. Where *T. stigmatica* exists without *T. thetis*, its dietary niche and browsing behaviour more closely mirror that of *T. thetis* (~~that is~~i.e.~~,~~ grazing on pasture by night)~~;~~ [3], [4]~~Vernes, 1995; Vernes, Marsh & Winter, 1995)~~. However, when these species are sympatric, *T. stigmatica*'s niche shifts to forest browse exclusively [2]~~(Jarman & Phillips, 1989)~~. Considering grassy ecotones were part of the pademelons' pristine habitat [5], [3]~~(Johnson, 1980; Vernes, Marsh & Winter, 1995)~~, the fundamental niche of both *T. thetis* and *T. stigmatica* is likely to include~~s~~ nocturnal grazing.

The competitive exclusion principle holds that no two species can have identical niches ~~(Attiwill & Wilson, 2006,~~[6, p. 352~~)~~]. Exploitative competition is most intense between congeneric species [6~~(Attiwill & Wilson, 2006~~, p. 288~~)~~]. According to Pianka's study in 1969, as cited in [7], this~~,~~ typically ~~leading~~ leads to niche differentiation and resource partitioning ~~(Pianka, 1969 cited in Azevedo et al., 2006)~~, whereby the out-competed species will widen its niche (i.e.~~,~~ niche compression hypothesis)~~;~~ ~~Attiwill & Wilson, 2006~~[6~~,~~ p. 356~~)~~]. ~~Considering~~ As *T. stigmatica's* dietary niche is similar to that of *T. thetis* when the species are not sympatric, the wider niche exhibited by *T. stigmatica* at the Dorrigo site marks it as the competitive 'loser'. This is supported by its lower population density at sites where it is sympatric with *T. thetis* ~~(~~[3]~~Vernes, 1995)~~.

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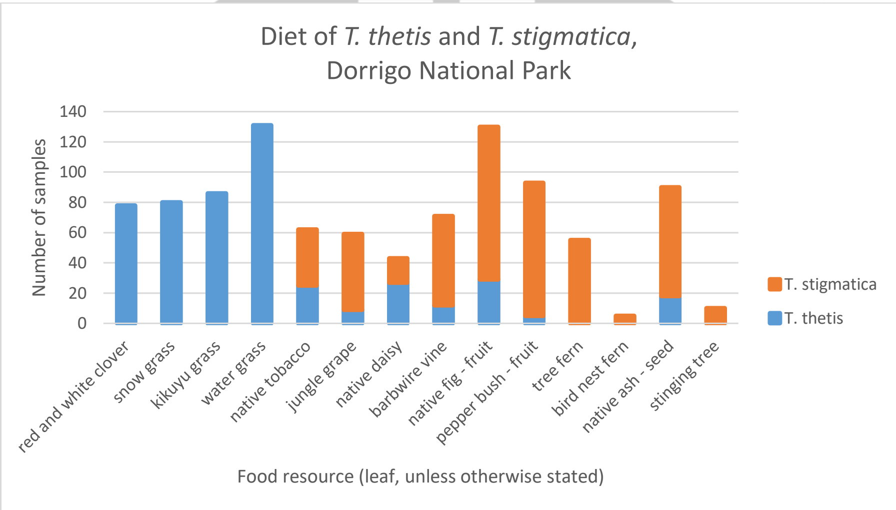
The p~~P~~ercentage overlap between the two species was calculated at 22.8% (using Pianka's index). When considered in light of overlap values found in other studies of mammals of the same tropic level (discussed below), this overlap is quite small, suggesting that there is only minimal resource competition between *T. thetis* and *T. stigmatica*. Indeed, as ~~was~~ seen in ~~Figure~~ Fig. 1 ~~above~~, while *T. thetis's* observed diet, like that of *T. stigmatica*, contained more forest leaves than fruit, and more fruit than seeds, *T. thetis* consumed these resources in much smaller quantities, suggesting minimal competition. ~~Figure~~ Fig. 2 illustrates this in more detail.



~~Figure~~ Fig. 2. Food resources shared by *T. thetis* and *T. stigmatica*

T~~hat t~~his overlap value is low, a~~i~~s supported by previous studies. For example, Cupples et al.~~, Crowther, Story and Letnic~~'s ~~(2011)~~ study applied Pianka's index to the dietary overlap of sympatric foxes and dingoes at three Australian desert sites [7]. They found a high overlap of ≥85%, ~~and~~ suggesting~~ed~~ that dietary competition between the species was likely [7]. Jarman and Phillips ~~(~~[2~~1989~~, pp. 146–147~~)~~] used a similar method of percentage overlap to compare the diets of three macropod species in northern NSW. The highest overlap (73.9%) was found between *Macropus giganteus* (*M. giganteus*, Eastern Grey Kangaroo) and *Macropus rufogriseus* (*M. rufogriseus*, ~~(~~Red-necked Wallaby), while a low overlap (26.5%) was found between *Macropus dorsalis* (*M. dorsalis*, ~~(~~Whiptail Wallaby) and *M~~.~~ rufogriseus*.

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~~For~~ The high overlap percentage of *M. giganteus* and *M. rufogriseus*~~, their high overlap percentage~~ reflected their consumption of similar proportions of the same grasses (mostly *Axonopus affinis* and *Paspalum dilatatum*). ~~By~~ In contrast, *M. dorsalis* favoured *Imperata cylindrica* and *Themeda triandra*, which *M. rufogriseus* appeared to consume in the smallest quantities.

The low overlap (26.5%) between *M. dorsalis* and *M. rufogriseus*, explained in terms of resource partitioning, demonstrates that the 22.8% overlap found for *T. thetis* and *T. stigmatica* is also low. Indeed, while Jarman and Phillips’s ~~(1989, p. 146)~~ study did not provide a dietary niche overlap percentage for *T. thetis* and *T. stigmatica*, it did consider the diets of both species, reporting that *T. stigmatica* ~~to be~~was ‘distinctly different’ from the other species discussed [2, p. 146]. This suggests support for the findings from the Dorrigo sample, in that the niche overlap of a distinctly different species ~~would be~~is low.

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References

[1] ~~Krebs,~~ C. J. Krebs, ~~. (1989). 'Chapter 13: Niche measures and resource preferences'. In~~ *Ecological methodology*. New York: Harper & Row, 1989~~(pp. 455–495).~~
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[2] ~~Jarman,~~ P. J. Jarman and~~& Phillips,~~ C. M. Phillips, ~~(1989).~~ 'Diets in a community of macropod species', ~~i~~In ~~G. Grigg, P. Jarman & I. Hume (eds.),~~ *Kangaroos, wallabies and rat-kangaroos*, G. Grigg, P. Jarman and I. Hume Eds. Chipping Norton, ~~(pp. 143–149).~~ ~~New South Wales~~NSW: Surrey Beatty & Sons~~.~~, 1989, pp. 143–149.

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[4] ~~Vernes,~~ K. Vernes *et al.*~~, Marsh, H. & Winter, J.~~, ~~(1995).~~ 'Home-range characteristics and movement patterns of the red-legged pademolon (*Thylogale stigmatica*) in a fragmented tropical rainforest', *Wildl~~life~~. Res.~~earch~~*, vol. 22, pp. 699–708, 1995.

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[6] ~~Attiwill,~~ P. Attiwill and~~&~~ ~~Wilson,~~ B. Wilson, ~~(2006).~~ *Ecology: An Australian perspective*, ~~(~~2nd ed.~~)~~. Melbourne, VIC: Oxford University Press~~: Melbourne~~, ~~.~~2006.

[7] ~~Azevedo,~~ F. C. C. Azevedo~~,~~ ~~*Lester, V., Gorsuch, W., Lariviere, S., Wirsing, A. J. & Murray, D. L.*~~ *et al.*~~(2006)~~, 'Dietary breadth and overlap among five sympatric prairie carnivores', ~~Journal~~ *J.* ~~of~~ *Zool.*~~ogy~~, vol. 269, pp. 127–135, 2006.

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~~Vernes, K., Marsh, H. & Winter, J. (1995). 'Home-range characteristics and movement patterns of the red-legged pademolon (*Thylogale stigmatica*) in a fragmented tropical rainforest'. *Wildlife Research*, 22, 699–708.~~

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TABLE I

COMPOSITION OF THE DIETS OF *T. THETIS* AND *T. STIGMATICA*

Food resource	***T. thetis***	***T. stigmatica***
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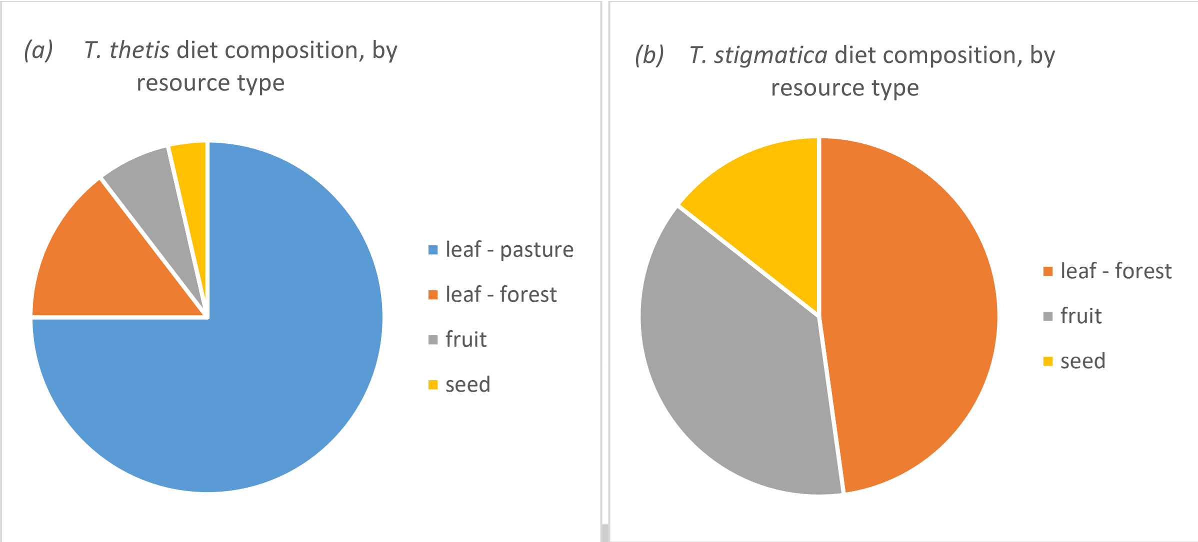

Fig. 1. Comparison of the composition of the diets of *T. stigmatica* and *T. thetis* by resource type: Pasture or forest browse (forest leaf, fruit and seed).

These findings are supported by previous observations for communities in which *T. thetis* and *T. stigmatica* were sympatric [2]. Where *T. stigmatica* exists without *T. thetis*, its dietary niche and browsing behaviour more closely mirror that of *T. thetis* (i.e. grazing on pasture by night) [3], [4]. However, when these species are sympatric, *T. stigmatica*'s niche shifts to forest browse exclusively [2]. Considering grassy ecotones were part of the pademelons' pristine habitat [5], [3], the fundamental niche of both *T. thetis* and *T. stigmatica* is likely to include nocturnal grazing.

The competitive exclusion principle holds that no two species can have identical niches [6, p. 352]. Exploitative competition is most intense between congeneric species [6, p. 288]. According to Pianka's study in 1969, as cited in [7], this typically leads to niche differentiation and resource partitioning, whereby the out-competed species will widen its niche (i.e. niche compression hypothesis) [6, p. 356]. As *T. stigmatica's* dietary niche is similar to that of *T. thetis* when the species are not sympatric, the wider niche exhibited by *T. stigmatica* at the Dorrigo site marks it as the competitive 'loser'. This is supported by its lower population density at sites where it is sympatric with *T. thetis* [3].

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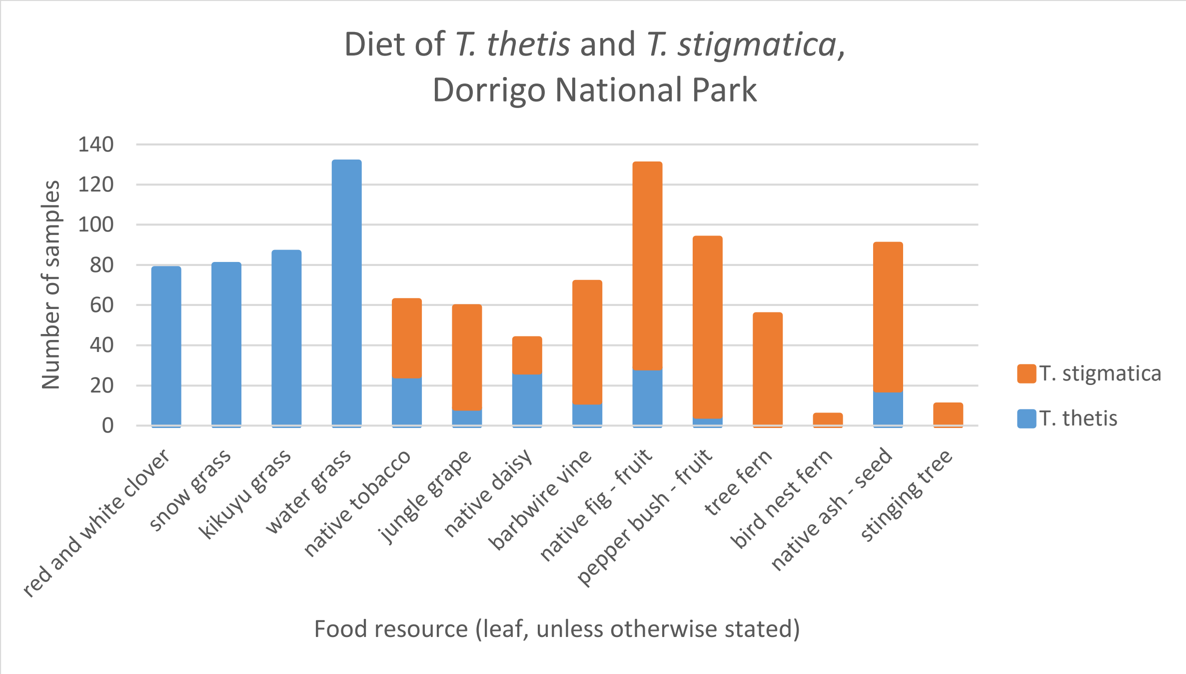

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References

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