Science for Saving Species

Research findings factsheet

Project 1.1.4

Threatened Species Recovery Hub

National Environmental Science Programme

Intraguild predation among marsupials and arthropods

In brief

Foraging is a fundamental behaviour that enables animals to meet their energy and nutrient requirements. However, as food resources are limited, competition arises between foragers seeking to acquire them. Different species will often resolve this competition by exploiting a niche or consuming those shared resources differently across time and/or space.

Intraguild predation (IGP), however, is a distinctive form of this competition. IGP occurs when a dominant predator selectively kills and eats smaller rivals to gain increased access to the food resources that they share. This kind of interaction has been well documented for carnivores within the same Order (for example, wolves and coyotes, and lions and hyenas); however, few studies have examined IGP between predators from very different taxonomic groups. In this case, we investigated selective predation by a mammal on an arthropod that has a very similar diet.

The lesser hairy-footed dunnart is a common insectivorous marsupial in arid Australia that consumes wolf spiders disproportionately often compared to their availability. We investigated the reasons behind this interaction and found that the dunnarts prey on wolf spiders in order to reduce competition for shared food resources.

Context

Ecological guilds are groups of animals that share resources or exploit them in a similar manner, regardless of their taxonomic type. The guild concept was developed to explain competition between species, which is most intense between members of the same guild. There are many kinds of competition. A distinctive type – interference competition – occurs frequently between carnivores, and is characterised by aggressive interactions. Intraguild predation (IGP) is a unique and extreme form of it, where a dominant predator selectively kills and eats subordinate rivals in the same guild to gain advantage in competition for food resources. For example, dingoes will kill and sometimes eat the invasive red fox, which hunts the same prey.

Most examples reported of IGP have been between species of similar taxonomy. However, recent studies have found that an insectivorous marsupial, the lesser hairy-footed dunnart (*Sminthopsis youngsoni*) consumes wolf spiders (Family Lycosidae) in a way that is disproportionate, considering their availability and that of other spiders. Both species are abundant and widespread in arid Australia, including in the Simpson Desert where the present study was carried out. Both the dunnart and the spider are nocturnal and generalist insectivores and occupy a range of microhabitats, such as spinifex hummocks and open sand. These similarities mean that the potential for their diets to overlap in space and time is high, and thus the potential for IGP is also high.

Dunnart eating wolf spider. Photo: Tamara Potter

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Our aims

We aimed to uncover the reasons behind this observed pattern of selective predation of the lesser hairy-footed dunnart on wolf spiders. This involved testing two hypotheses:

1. Lesser hairy-footed dunnarts prey on wolf spiders selectively due to their relatively high energy, protein or fat content compared to that of other available arthropod prey.
2. The disproportionate predation is a product of frequent encounter rates between the two species due to high overlap in their diets and use of space and time.

*A captured lesser hairy-footed dunnart (*Sminthopsis youngsoni*) held in a calico bag for identifying, weighing and measuring. Photo: Tamara Potter*

What we did

We set out, first of all, to test whether wolf spiders have relatively high energy or nutrient contents compared to other invertebrates. To do this, we collected representatives of nine arthropod families, including the wolf spiders that are eaten by the lesser hairy-footed dunnart in the Simpson Desert. We then ran a series of laboratory tests to gain an understanding of the energy, fat and protein composition of these invertebrates.

Meanwhile, we determined the diet and prey availability of both species groups using a variety of methods. Direct observations were supported by pitfall trapping. We live-captured individuals of both species groups, marked them and then released them at the point of capture. We identified and weighed the dunnarts and checked their sex and reproductive status; and identified, weighed and checked the sex of the spiders.

This trapping also helped us learn about the diet composition and overlap of the two species groups, as well as about their preferences for different microhabitats. When we released the captured dunnarts and spiders, we followed them to directly observe them selecting their prey. We secured glow sticks to the dunnarts and attached silver reflective tape to the spiders to better observe these nocturnal foragers. A total of 10 lesser hairy-footed dunnarts were followed in October 2016, and May and October 2017, with prey capture witnessed on 13 occasions. Seventeen wolf spiders were observed over the same period, with 30 prey captures recorded.

We deepened our understanding of the food availability and selection for both spiders and dunnarts through the use of invertebrate pitfall trapping. The captured invertebrates we identified to Order, except for spiders, bees, wasps and ants, which we identified to Family. We also counted the trapped invertebrates, and grouped them into seven size classes from <2mm to >20mm, based on total body length from head to abdomen. This helped us to determine whether the predators prefer prey of different sizes.

The activity of both species over 24-hour time periods was investigated through spotlighting and camera traps.

Microhabitats present in the Simpson Desert, including spinifex hummocks preferred by wolf spiders and patches of bare sand. Photo: Tamara Potter

Key findings

Our first key finding was that wolf spiders do not contain significantly more energy, protein or fats than other arthropod prey available to dunnarts. This served to immediately discredit our first hypothesis that the lesser hairy-footed dunnart forages selectively on wolf spiders to optimise its caloric or nutritional intake.

However, similarity in food types eaten by these two species was 83%, signifying major dietary overlap. (Overlap similarity of more than 75% implies that two predators are consuming effectively the same prey in similar proportions.) This is borne out by the findings. Wolf spiders preyed most often on ants (23% of observations), other spiders (20%) and moths (17%). The lesser hairy-footed dunnarts most often consumed ants and spiders (74% combined), with wolf spiders constituting 13% of all dunnart prey captures. Observed overlap in prey sizes was 68%.

Prey size is an important consideration when looking at prey overlap, as even when two species eat the same prey, competition can be reduced if they target different-sized prey. Our finding, however, is that there is no significant difference between the lesser hairy-footed dunnart and the wolf spider when it comes to the size of the prey they forage on. This is despite the difference in size between the two species. Dunnarts can eat prey of almost any size up to their own body mass (around 11 g), while wolf spiders can eat prey at least three times their size (around 10mm). These results strongly suggest that these two species can be designated as members of the same dietary guild, and they also reinforce the idea of guilds grouping species onthe basis of shared resources regardless of how closely related they may or may not be.

*A lesser hairy-footed dunnart (*Sminthopsis youngsoni*) snacking on a grasshopper. Photo: Tamara Potter*

Our spotlighting surveys revealed that both species were completely nocturnal. Wolf spiders are active throughout the night, with their activity peaking around 11 pm to midnight, while dunnarts' activity peaks a little earlier in the evening and they remain active until later in the morning. While there was some temporal partitioning (the peak in the activity of wolf spiders corresponding with a simultaneous relative lull in dunnart activity), a high degree of overlap (79%) was identified between wolf spiders and dunnarts over a 24-hour period. The slight mismatch between times of peak activity may reduce the otherwise high encounter rates between the species and predation by dunnarts on wolf spiders, thereby enabling their co-existence.

The results for microhabitat use were more subtle. Both species used the same microhabitats in the study area, but in different proportions. Wolf spiders exhibited a preference for greater spinifex cover and less bare ground, suggesting that they may use spinifex as a refuge to minimise predation by dunnarts and against other threats.

Previous research has demonstrated that wolf spiders can detect cues about predators and therefore avoid them and, in circumstances where intense competition is likely, such as with dunnarts in the Simpson Desert, there is a strong selective advantage for species to use food, habitat and activity differently over a 24-hour period to make co-existence easier or possible. Taken together, these findings suggest that the avoidance of the wolf spider towards the larger predator the dunnart is associated with IGP, and point to the conclusion that the hairy-footed dunnart may prey on wolf spiders to reduce competition for the same food resources.

This study is one of very few to suggest IGP between such taxonomically disparate groups. It has presented unique insight into the complexity of ecological interactions in an arid environment. The implications of the study extend beyond simple predator–prey relationships to suggest that IGP can have substantial impacts on the structure, diversity and stability of ecological communities, with resulting impacts on ecosystem processes.

"This study has presented unique insight into the complexity of ecological interactions in an arid environment."

Recommendations

The climatic conditions at the Simpson Desert site are highly unpredictable. As a consequence, the availability of food and microhabitat are likely to fluctuate depending on whether it is a "boom" or "bust" period. A further implication is that the degree of overlap in diet and microhabitat use between the hairy-footed dunnart and wolf spider is also likely to change with these climatic fluctuations.

Given this, our project provides only a glimpse of the spectrum of interactions that may occur between these two species groups. It would be valuable to quantify diet, microhabitat use and temporal overlap over several wet and dry years. This would help to assess whether our conclusions hold true as a generality or represent an exception based on the wet conditions that prevailed during the study period.

Cited material

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A wolf spider (Family Lycosidae). *Photo: Tamara Potter*

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This project is supported through funding from the Australian Government's National Environmental Science Program.