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Letter to the Editor

Enough dogma: Seeking the middle ground on the role of dingoes

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Abstract Numerous recent studies present evidence that Australian dingoes *Canis lupus dingo* can benefit native biodiversity by suppressing mesopredators and large herbivores. Allen and colleagues have challenged the reliability of this evidence. Although they make some valid criticisms, I question some of their assertions. While the existing evidence is inconclusive, I argue that to dismiss it completely would be just as dangerous as to embrace it uncritically. I aim to establish a middle ground [*Current Zoology* 58 (6): 856–858, 2012].

Keywords Dingo, Feral cat, Fox, Keystone predator, Mesopredator release, Wild dog

Around the globe, apex predators exert strong effects on mesopredators and prey, often with flow-on effects for biodiversity at lower trophic levels (e.g. Terborgh et al., 2001; Ritchie and Johnson, 2009; Estes et al., 2011; Ritchie et al., 2012). The dingo *Canis lupus dingo* is the largest terrestrial predator in Australia. (Although hybridisation occurs between dingoes and domestic dogs *C. l. familiaris*, for simplicity I use the term dingo throughout). Ecological theory predicts, and empirical evidence increasingly suggests, that dingoes can benefit native biodiversity by suppressing mesopredators (foxes *Vulpes vulpes* and feral cats *Felis catus*) and large herbivores (Letnic et al., 2012). Allen et al. (2011a) recently reviewed this evidence and found that most studies suffered from methodological flaws (but see response by Letnic et al., 2011). They therefore argued that these studies could not be used to make reliable inference, and that the evidence for the ecosystem functions of dingoes is not as strong as previously supposed (Allen et al., 2011b). In challenging the view of Allen et al. (2011b) it is necessary either to: 1) demonstrate that the studies reviewed did not have methodological flaws or 2) challenge the assertion that these flaws led to unreliable conclusions. In this short comment, I address the latter.

Allen et al. (2011a) identify limitations in the methodologies of some recent studies, which undoubtedly cause some uncertainty in the results of those studies. For example, Letnic et al. (2009) used spoor counts to derive activity indices for dingoes and foxes on either side of the dingo barrier fence, which excludes dingoes from large areas of south-eastern Australia. This method has been criticised by Allen et al. (2011a). I agree that spoor counts provide only a coarse measure of predator activity. However, when the observed effect size is very large, coarse measures may be sufficient. At two sites, fox activity was ~2–3 times higher in the absence of dingoes. At a third site, foxes were only detected where dingoes were excluded (Letnic et al., 2009). These results are consistent with other cross-fence comparisons (e.g. Newsome et al., 2001; Letnic and Dworjanyn, 2011) in which fox activity has been approximately seven- to twenty-fold higher in the absence of dingoes. Similarly large differences occur in populations of some threatened prey species, which are more abundant where dingoes are common and foxes scarce (e.g. Letnic et al., 2009). These effect sizes are too large to be dismissed as artefacts of coarse measurements.

Contrary to this, Allen et al. (2011b) assert that these studies each have an unknown (but greatly reduced) inferential value. As the sum of many unknowns is still an unknown, they argue that meta-patterns emerging from recent studies are also unreliable. Such a view would only be justified if the limitations of these studies created a systematic bias towards a particular conclusion, but this is not the case. Therefore, when the results of numerous (albeit imperfect) studies are consistent with each other, and with theoretical predictions, there is

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strong support for those predictions. Hence, while some individual results may be inconclusive, the overall patterns that particular species are more or less common in the presence of dingoes are robust.

Given the strong correlations between dingoes, mesopredators and prey, the key remaining questions relate to the causal mechanisms. While top-down regulation by dingoes is one hypothesis, alternative explanations have been offered, including habitat preferences or patterns of livestock grazing (e.g. Allen, 2011). These alternative mechanisms are not mutually exclusive, and may interact. For example, the ability of dingoes to suppress cats may depend on habitat characteristics (Edwards et al., 2002; Kennedy et al., 2012). Ideally, the mechanisms should be clarified by manipulative experiments. Definitive experiments to test the ecological role of dingoes are theoretically possible, as outlined by Glen et al. (2007a), but logistically and financially impracticable because they would have to be conducted at an enormous scale, both temporally and spatially. Given these practical constraints, I suggest an adaptive management approach, in which dingoes are reintroduced only in selected areas where the risks to livestock and native prey are low. The use of fenced areas (e.g. Moseby et al., 2012) is a good example of this approach as it prevents dingoes spreading to areas where they may be undesirable. Such manipulations may provide the most rigorous test yet of the dingo's role. Measuring the outcomes of dingo control operations can also provide valuable insights into their effects on mesopredators and prey. Similar suggestions have been made by Fleming et al. (2012).

I share the view of Allen et al. (2011b) that evidence for beneficial effects of dingoes should not be generalized to all situations. They describe a case in which dingo control was ceased in an unsuccessful attempt to protect a critically endangered wallaby population from mesopredators. Indeed, Glen et al. (2007a) warned against such an approach, noting that critically endangered populations may be unable to withstand predation from any source, including dingoes (see also Allen and Fleming, 2012). It is important to remember that the effects of dingoes on other species can be positive or negative, and will vary between different times and places. Hence it is premature to call for widespread cessation of dingo control on biodiversity protection grounds.

Although I agree with Allen et al. (2011b) on some points of methodology, at times they make selective and potentially misleading arguments. In stating that canid control has never had negative impacts on populations of threatened species, they cite Glen et al. (2007b) and APVMA (2008). These reviews discuss the potential for incidental poisoning of non-target species when controlling canids with toxic baits. They do not refer to the ecological impacts of removing an apex predator. At the same time, Allen et al. (2011b) ignore several examples (reviewed by Glen and Dickman, 2005; Glen et al., 2007a) in which dingo control has apparently led to undesired consequences. For example, shortly after dingoes were controlled in the Tanami Desert, foxes moved into the area (Short et al., 2002). This was believed responsible for the local extinction of endangered rufous hare-wallabies *Lagorchestes hirsutus* (Lundie-Jenkins et al., 1993), although overgrazing (Allen, 2011) and subsequent dingo predation (Corbett, 2001) may have been responsible for their endangered status in the first place. Irruptions of feral cats have also been recorded following dingo control in some places (Pettigrew, 1993; Christensen and Burrows, 1995) but not others (Eldridge et al., 2002; Kennedy et al., 2012). It would therefore be misleading to suggest that no evidence exists for increased impacts of mesopredators following dingo control.

In conclusion, I concur with Allen and colleagues that the current evidence for top-down regulation by dingoes is inconclusive. However, I assert that the qualitative relationships observed between dingoes, mesopredators and some threatened species are valid despite the limitations they describe. Recent contributions have improved our understanding enormously, and to dismiss them completely would be just as dangerous as to embrace them uncritically. The ecological role of dingoes needs further study. Future research should aim (where possible) to adopt a manipulative approach, and account for design issues that might weaken their inferential ability.

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