

# What to call a dog? A review of the common names for Australian free-ranging dogs

T. L. Kreplins<sup>A,E</sup>, A. Gaynor<sup>B</sup>, M. S. Kennedy<sup>C</sup>, C. M. Baudains<sup>A</sup>,  
P. Adams<sup>A,C</sup>, P. W. Bateman<sup>D</sup> and P. A. Fleming<sup>A</sup>

<sup>A</sup>School of Veterinary and Life Science, Murdoch University, 90 South Street, Murdoch, WA 6150, Australia.

<sup>B</sup>School of Humanities, The University of Western Australia, 35 Stirling Highway, Crawley, WA 6009, Australia.

<sup>C</sup>Department of Primary Industries and Regional Development WA, 3 Baron-Hay Court, South Perth, WA 6151, Australia.

<sup>D</sup>School of Molecular and Life Sciences, Curtin University, Bentley, WA 6102, Australia.

<sup>E</sup>Corresponding author. Email: [t.kreplins@murdoch.edu.au](mailto:t.kreplins@murdoch.edu.au), [traceykreplins@gmail.com](mailto:traceykreplins@gmail.com)

**Abstract.** Wildlife research is informed by human values and interests, and these are reflected in, and reinforced by, the language used to describe particular species and animals. Examining factors that influence the use of common names of contentious taxa such free-ranging dogs is important, as naming can influence the design and reception of scientific studies. There are a range of common names for free-ranging dogs in Australian scientific literature but the most common names are ‘dingoes’ and ‘wild dogs’. This review investigated influences on the terminology used to describe Australian free-ranging dogs in scientific studies from October 1952 to January 2018. Using a multidimensional scaling analysis, we tested the effects of several potential factors on terminology around Australian free-ranging dogs. We found a significant correlation between studies that reported on ‘wild dog’ control within livestock production–focussed papers and the use of the term ‘dingo’ and discussion of mesopredator release in conservation-related papers. There was a bias associated with author employment, with studies funded by a livestock production organisation more likely to employ ‘wild dog’ terminology. Year of publication and dingo purity within the locale of the study made a lesser contribution to differences in terminology. Our study explores the contextual factors that influence the choice of common names in scientific papers. Although referring to the same species, this review highlights that common terminology within scientific papers is reliant on the discussion of mesopredators release, control programs and the paper’s context.

**Additional keywords:** conservation, dingo, domestic dog, feral dog, hybrids, mesopredator, pest control, wild dog

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## Introduction

Language and use of terminology shapes how we understand and regard the world around us. In particular, naming communicates human values and confers power (Thagard 2002). The terminology (common or scientific) used to refer to an animal is imbued with meaning, assumptions and subjectivity (Alvesson and Kärreman 2000). While scientific research employs methods to ensure its objectivity, choice of common names used in formulating questions and reporting results can potentially influence the way it is received by scientific colleagues and the general public.

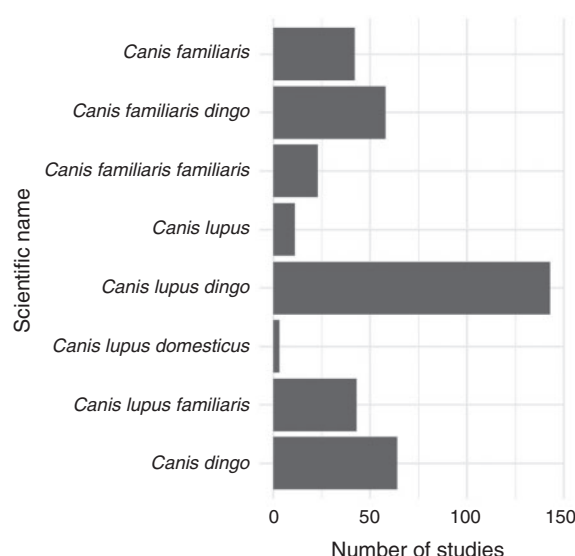
Naming of Australian free-ranging dogs (*Canis familiaris*) (Jackson *et al.* 2017; Box 1) in scientific literature is a prime example of how naming a species can be controversial, emotive and involve diverse opinions. Many terms have been used to describe these dogs, and it is apparent that multiple factors influence the choice of names. For the purpose of this review we

follow Fleming *et al.* (2013) and use the term ‘free-ranging dogs’ for all versions of ‘dingoes’, ‘wild dogs’, ‘hybrids’ and any other associated terms, as it is an ‘accurate, inclusive, generic, and non-emotive descriptor’. The authors acknowledge that not everyone will view this term as free from any emotional value but it is hoped that it covers all descriptors of ‘free ranging dogs’.

The common names in use for free-ranging dogs are ‘dingoes’ and ‘wild dogs’ and additional terms referring to hybrids of these taxa (e.g. hybrids, cross-breeds). The common name ‘dingo’ is usually reserved for ‘pure’ dingoes, especially those that are golden or tan in colour (and, to a lesser extent, black and tan, or all white: Newsome and Corbett 1985), living wild and descended from the first introductions 3500–5000 years ago, mostly likely as a result of transport by Asian seafarers (Corbett 1995; Savolainen *et al.* 2004). A second and continuing introduction of domestic dogs into Australia with European arrival

**Box 1. Scientific nomenclature of Australian free-roaming dogs**

All dogs in Australia, be they domesticated, feral, naturalised, colloquially named ‘dingoes’ or ‘wild dogs’ etc., can hypothetically interbreed freely with whatever subgroup of the grey wolf (*Canis lupus*) was first domesticated (10 000–16 000 years ago: Olsen 1985) (but possibly up to 100 000 years ago: Vilà *et al.* 1997). This has led to ambiguity of scientific nomenclature, with many synonyms used, including *Canis lupus dingo*, *Canis familiaris dingo*, *Canis dingo*, *Canis lupus familiaris*, and *Canis familiaris familiaris*. There is a reasonable amount of disagreement regarding species status of the dingo, coupled with problems associated with the nomenclatural rules around issuing subspecific status to domesticated animals (Jackson and Groves 2015). The first dogs to arrive in Australia must have been brought through human agency, and would therefore have been ‘domesticated’ when they arrived, which suggests that *Canis familiaris* is the appropriate binomial, even for ‘dingoes’ (Jackson and Groves 2015; Jackson *et al.* 2017).



The scientific terminology used to describe dogs in the 436 reviewed papers varied (only 387 papers used scientific terms; some used multiple): *Canis familiaris* ( $n = 42$ ), *Canis familiaris dingo* ( $n = 58$ ), *Canis familiaris familiaris* ( $n = 23$ ), *Canis lupus* ( $n = 11$ ), *Canis lupus dingo* ( $n = 143$  papers), *Canis lupus domesticus* ( $n = 3$ ), *Canis lupus familiaris* ( $n = 43$ ), and *Canis dingo* ( $n = 64$ ).

~200 years ago has contributed to the free-ranging dog population (Gentle *et al.* 2017). It is important to note here that coat colour does not indicate genetic purity or a degree of hybridisation. A hybrid can be a tan individual and a pure ‘dingo’ can have a brindle coat (Newsome and Corbett 1985) (see Fig. 1 for images of free-ranging dogs in Western Australia). The term ‘wild dog’ is often used as a broader term to include ‘pure’ dingoes, free-ranging domestic dogs, and their hybrids. Variability in application of common names leads to confusion in dealing with high-profile public issues associated with free-ranging dogs. Wildlife management practitioners may consider the effects of dingoes to be positive but the effects of wild dogs to be negative, without recognition that the two common names refer to overlapping categories of free-ranging dogs.

Over time, perceptions of free-ranging dogs have changed and our changing values have influenced the use of common names in scientific literature. Free-ranging dogs have long been (and remain) an important part of Aboriginal communities across the continent (Box 2), valued for warmth, companionship,

hunting and as a food source (Hamilton 1972). Since European colonisation, with the provision of new water supplies (e.g. bores and dams) and novel food sources (e.g. livestock and rabbits), free-ranging dogs from both pre- and postcolonisation sources have increased in density and distribution range across Australia (Allen and West 2013). Livestock predation led many colonists to view dogs as a pest and this view continues to this day, with dog control being carried out in the form of fencing, poison baiting, trapping and shooting (Fleming *et al.* 2001). Today, control of free-ranging dogs continues with the aim of reducing the impact of predation on the livestock industry.

Free-ranging dogs usually associated with the term ‘dingo’ have also become Australian icons, though this status has been accompanied by some ambivalence and controversy (Peace 2002; Trigger *et al.* 2008). From the 1960s, as scientific and popular concern about the fate of Australian flora and fauna increased, so did sympathy for the dingo (Serventy 1966). There are now many wildlife sanctuaries in Australia that promote the



**Fig. 1.** Images of free-ranging dogs captured on camera traps in the southern rangelands of Western Australia (59% of free-ranging wild dogs in Western Australia have  $\geq 90\%$  dingo ancestry; Stephens *et al.* 2015). These images were all captured on the same two pastoral stations located  $\sim 70$  km apart. Some images are of multiple individuals, which are likely to be related. Photographs: T. Kreplins.

image of a dingo and the pure-breed dingoes of K'gari (Fraser Island) are a tourist attraction. However, dingoes on the island have been controlled for their negative interactions with humans (Burns and Howard 2003; Hytten and Burns 2007).

In recent decades, free-ranging dogs have also increasingly been identified as potential ecosystem engineers (Letnic *et al.* 2012). The mesopredator-release hypothesis (Crooks and Soule 1999; Glen *et al.* 2007; Newsome *et al.* 2015) suggests that when the top-order predators are removed (e.g. free-ranging dogs are controlled), then mesopredators such as the red fox (*Vulpes vulpes*) and feral cat (*Felis catus*) are released from interference or competitive pressure and their predation impacts are increased (Ritchie and Johnson 2009). As the top-order predator in Australia, free-ranging dogs are thereby theorised to suppress the activities and behaviour of small mesopredators and thus reduce the predation pressure on small prey, for example, native species such as the dusky hopping mouse (*Notomys fuscus*) (Letnic and Koch 2010). Examination of the mesopredator-release hypothesis in Australia has led to polarisation in the scientific literature regarding the role of free-ranging dogs as top-down regulators of introduced predators (e.g. Glen *et al.* 2007; Doherty and Ritchie 2017; Allen *et al.* 2017).

Today, the degree of genetic purity of dingoes (i.e. the degree of similarity to the immediate precolonisation dogs) varies across the continent. As this is likely to affect contemporary perceptions of the animals, the location of study may influence common name usage within the scientific literature. For example, dingo purity in Western Australia and the Northern Territory is relatively high ( $\sim 59\%$  and  $87\%$  respectively of free-ranging wild dogs have  $\geq 90\%$  dingo ancestry). In comparison,

there is a greater degree of hybridisation on the east coast of Australia (1% dingoes in the free-living dog population in Victoria) (Stephens 2011; Stephens *et al.* 2015). This, as well as other factors, such as stakeholder interest, dominant livestock enterprises and impacts from free-ranging dogs, contributed to each state and territory in Australia having different legislation around free-ranging dog control.

Examining factors that influence the use of common names of contentious taxa such as free-ranging dogs is important. Although we may believe we are being scientifically objective, the common name used in formulating questions and reporting results can potentially influence both the design of the study and the way it is received by scientific colleagues and the general public. Scientists from a range of employers and funders (who may use different terms for free-ranging dogs) can therefore benefit from recognising and reflecting on the ways in which context tends to shape the terms they use.

Here we review usage of common names for free-ranging dogs and seek to understand the application of common names for free-ranging dogs in Australian scientific literature. Common name usage is likely to be influenced by the operational context of the study, the study aims, study location, and even the funding sources and authors. We hypothesised that conservation-related papers (which commonly include examination of the mesopredator-release hypothesis) will preferentially use 'dingo' (e.g. Letnic *et al.* 2011). By contrast, 'wild dog' may be used more commonly in studies where control is carried out or for studies that address the impacts of dogs on livestock (e.g. Allen 2014), as a method of reducing emotional attachment to the dogs.



**Box 2. Indigenous naming of Australian free-roaming dogs**

The dingo's story is closely associated with that of the Aboriginal people of Australia. The word 'dingo' was recorded by [Tench \(1789\)](#) as the name used for the animal by the Dharuk-speaking Aboriginal people living near Botany Bay. Interestingly, 'dingo' may be a misunderstanding of the word 'tingo' meaning 'tame' ([Breckwoldt 1988](#); [Smith and Litchfield 2009](#)) and a 'wild' dog was called *warrigal* ([Cahir and Clark 2013](#)).

Just as in scientific nomenclature and in Australian English, it is evident that Aboriginal languages sometimes differentiate between 'domesticated' dogs and the dingoes: [Hamilton \(1972\)](#) reports that, amongst the Jankuntjara (Yankunytjatjara) people, 'all dogs are *papa* and wild dogs are *papa inuru*'. Amongst the Warlpiri of the central deserts 'the name *maliki* is applied to dingoes generally, but *wanapari* refers specifically to wild dingoes and *tjarntu* to domesticated dingoes' ([Burbidge \*et al.\* 1988](#)). Differences in nomenclature for the dingo may reflect [Hamilton's \(1972\)](#) hypothesis that for Aboriginal peoples there is a continuum between 'dingoes' tamed as pets and later European dogs, but also that there is an elaborate relationship between Aboriginal societies and the dingo, which can be 'guard dog, hunting dog, companion animal, emotional comfort, campsite cleaner, object of bartering, competitor for prey species, food or clothing source, status symbol, kin, and supernatural hybrid between human and nonhuman' ([Carter \*et al.\* 2017](#)).



(a) 'Men; Two Pintupi elders nursing dingo pups used for hunting purposes', Lake Mackay. Ted Evans Collection, Northern Territory Library. PH0121/0105. (b) 'Stray dog', Meekatharra. Photograph: P. A. Fleming.

## Methods

### *Data collation – peer-reviewed publications*

We searched for peer-reviewed scientific literature with the terms ‘dingo’ or ‘wild dog’ and ‘Australia’ in December 2016 and January 2018 (Appendix 1) (Moher *et al.* 2009) using the Murdoch University Web of Science, which includes searches of books, journals and conference proceedings. At the time of these searches, the Web of Science subscription service included access to the Web of Science Core Collection, BIOSIS Citation Index, BIOSIS Previews, Current Contents Connect, CABI: CAB Abstracts, KVI-Korean Journal Database, Medline, SciELO Citation Index, Zoological Record (1864–1980), and Journal Citation Reports. We elected to use this inclusive database because some collections (e.g. Web of Science Core Collection) do not include access to key Australian journals; this would have limited our search outcomes. Our inclusive approach also reduced our reliance on one database (Calver *et al.* 2013). The Web of Science only searches for terms in titles of papers published before 1900 but expands this to titles, keywords and abstracts for more recent papers (Pautasso 2014); this artefact influences all our terminology searches equally. For each publication, we extracted title, authors, source, publication date, and number of citations for each year since publication.

All types of scientific papers were included, such as research, reviews, opinion, notes, letters to the editor and research publications. Only manuscripts accessible online were included in the review. Books, book chapters, conference proceedings, and unpublished literature were excluded from this search. For each study, we recorded the following:

- Common name used. To simplify analyses, each publication was categorised as having used the term ‘dingo’ only, ‘wild dog’ only, or multiple terms (‘both’) within the one paper. Other terms used for free-ranging dogs were noted.
- Date. To test for changes in common names over time, we recorded the year of publication (grouped by decade: 1950s–2010s).
- Livestock production employer. If the authors were employed by a company or institution that was related to, or involved with, livestock production (i.e. state government Departments of Agriculture or equivalent).
- Livestock production funding. If the authors and/or the study were funded by a company or institution that was related to, or involved with, livestock production (i.e. Meat and Livestock Australia or Australian Wool Innovation).
- Location/dingo purity. A percentage of dingo purity was assigned to each paper based on the location of the study (by state) or where the data were collected from (i.e. carcass collection). Dingo purity values were taken from Stephens *et al.* (2015). If a paper included study sites in two or more states, the purity values for those states were averaged. Papers that did not conduct experimental research (e.g. opinion pieces and letters to the editor and those that were Australia-wide) were assigned a value of 17% dingo purity based on Australia-wide values (Jones 1990; Corbett 2008).
- Context. Papers were categorised as conservation (no specific mention of livestock production and focus on the presence of dogs in native ecosystems) or livestock

production (examining the relationships between livestock and dogs).

- Control. Papers were categorised as reporting on free-ranging dog population control (i.e. baiting, shooting, trapping, aerial baiting, livestock guardian dogs) or using the data derived from a control method (i.e. carcasses from professional pest controllers) or not discussing anything to do with population control of free-ranging dogs.
- Mesopredator release. If the paper discussed the mesopredator-release hypothesis it was categorised as ‘yes’, otherwise ‘no’.

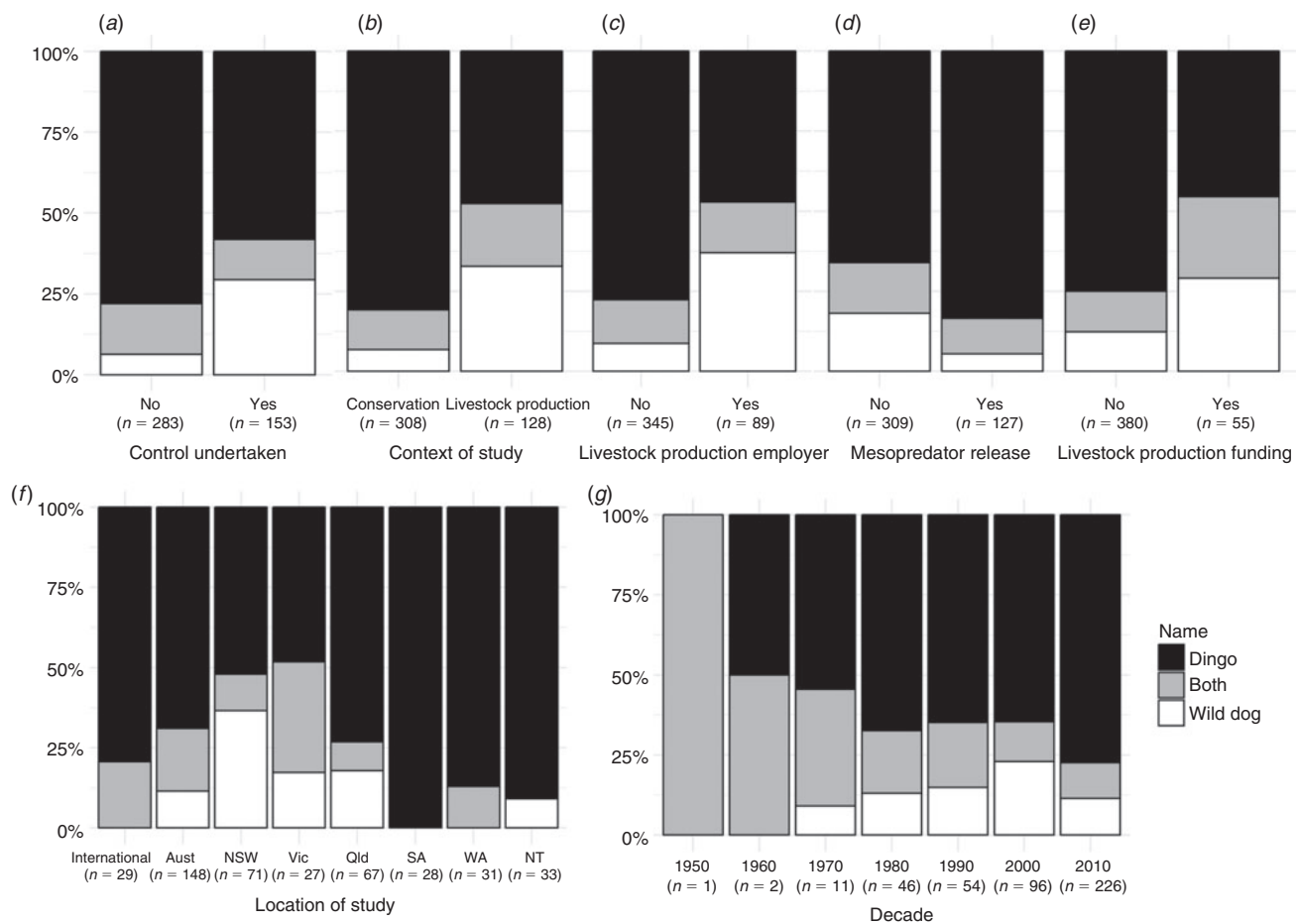
### *Analyses*

We examined the effect of seven variables (decade, livestock production employer, livestock production funding, location/dingo purity, context of the study, whether dog control was part of the methods and/or data was gained through dog control (i.e. analysis of carcasses), and whether mesopredator release was discussed in the paper) on the common name used in the paper (dingo, wild dog, or both terms). Correlations among the independent variables were tested by a Spearman Rank Order correlation. Similarity among papers in their study design or background (as measured by the independent variables) was estimated by using the Euclidean similarity index. A one-way PERMANOVA analysis (PAST 3.15 Paleontological Statistics: Hammer *et al.* 2001) was applied to the pairwise similarity matrix to determine whether common name was influenced by study design and/or background (Clarke 1993). The contribution of each independent variable to differences in common name usage was determined by Similarity Percentage (SIMPER) (PAST 3.15).

## Results

In total, 436 papers were reviewed. The earliest published manuscript was dated 1952. Overall, 310 papers used the common name ‘dingo’ only, and 63 used ‘wild dog’ only. The remaining 63 papers used both terms. Other terms used to describe the dogs included ‘hybrids’, ‘cross breeds’, ‘feral dogs’, ‘free roaming’, ‘wild-living’, ‘free-living dog’, ‘wild canid’, ‘canid’, or simply ‘dog’; because of the nature of our search, these terms were only recorded in conjunction with ‘wild dog’ and/or ‘dingo’. There were significant differences in the background factors for papers that used different terminology (‘dingo’, ‘wild dog’, or both) (PERMANOVA: Pseudo- $F = 17.92$ ,  $P = 0.0001$ ).

The strongest contributor to the differences between the use of the common names was whether or not a study included control activities or retrieved data from a control event (SIMPER: 24.06%) (Fig. 2a). Papers that either researched control efforts, effects on non-targets or gained data from control efforts (i.e. carcasses from a trapping program;  $n = 153$  studies) were more likely to use the name ‘wild dog’. Papers that did not discuss any form of control or use data that originated from control efforts (i.e. carcasses or bounties;  $n = 283$  studies) were more likely to use the name ‘dingo’. The inclusion of control was correlated with author employer, funding, and context of study, and showed a decrease in proportion over time (Table 1).



**Fig. 2.** Factors that influenced the use of the term 'dingo', 'wild dog' or both in 436 peer-reviewed papers, listed in order from most to least significant. (a) Population control (i.e. baiting, shooting or trapping) was carried out as part of the study (similarity percentage [SIMPER] analysis indicated that control contributed to 24.06% to the overall variation in names). (b) The paper is predominantly conservation or livestock production oriented (SIMPER: 21.84%). (c) The authors were employed by livestock production-related companies (SIMPER: 21.02%). (d) The paper discussed the mesopredator-release hypothesis (SIMPER: 14.7%). (e) The study was funded by livestock production-related companies (SIMPER: 11.87%). (f) Location of the study: States are ordered from left to right in increasing order of dingo genetic purity (SIMPER for genetic purity of dingoes at the study site: 3.84%). (g) Decade of the study (SIMPER: 2.67%).

Studies identified as livestock production context ( $n = 107$  studies) were more likely to use the name 'wild dog', while conservation context papers ( $n = 329$  studies) were more likely to use the name 'dingo' (SIMPER: 21.84%) (Fig. 2b). The context of the study was correlated with author employer, funding, and no mention of mesopredator release, and there was an increase in the proportion of conservation studies over time (Table 1).

Authors employed in industries funded through livestock production ( $n = 89$  studies) were more likely to use the name 'wild dog', while other authors ( $n = 345$  studies) were more likely to use the name 'dingo' (SIMPER: 21.02%) (Fig. 2c). Authors employed in a livestock production capacity were more likely to receive funding through livestock production industries (Table 1).

Papers that discussed the mesopredator-release hypothesis ( $n = 130$  studies) were more likely to use the name 'dingo' (SIMPER: 14.70%) (Fig. 2d). There was an increase in mesopredator-release hypothesis studies over time (Table 1).

Studies funded by a livestock production company or institution ( $n = 55$ ) were more likely to refer to 'wild dogs' (SIMPER: 11.87%) (Fig. 2e).

Common name usage varies across Australian States (Fig. 2f), which may relate to genetic purity of dingoes present at each location. The genetic purity of dingoes explains a small proportion of variation in 'dingo' and 'wild dog' terminology (SIMPER: 3.85%). This genetic purity measure was not significantly correlated with any of the other factors tested.

Durie and Riek (1952) was the earliest study published on free-ranging dogs and used both 'dingo' and 'wild dog' to describe the role played by free-ranging dogs in parasitic infestation in cattle. There has been increasing demarcation evident between 'dingo' or 'wild dog' over time and more recent papers use one or the other of these terms exclusively. The use of 'dingo' in scientific papers has been steadily increasing over time; use of the term has almost trebled over the last two decades. These changes over time are reflected in a small contribution to the overall choice of terminology (SIMPER: 2.67%) (Fig. 2g).

**Table 1. Spearman Rank Order correlations of the independent variables**

The independent variables are: decade, location/dingo purity, whether mesopredator release was discussed in the paper, livestock production employer, livestock production funding, context of the study, and whether dog control was a part of the methods and/or data was gained through dog control (i.e. analysis of carcasses). Correlations in bold are significant at  $P < 0.001$

|                               | Decade       | Location/dingo purity | Mesopredator release | Livestock production employer | Livestock production funding | Context of the study |
|-------------------------------|--------------|-----------------------|----------------------|-------------------------------|------------------------------|----------------------|
| Location/dingo purity         | 0.10         |                       |                      |                               |                              |                      |
| Mesopredator release          | <b>-0.43</b> | -0.04                 |                      |                               |                              |                      |
| Livestock production employer | -0.10        | 0.06                  | 0.14                 |                               |                              |                      |
| Livestock production funding  | -0.09        | 0.04                  | 0.11                 | <b>0.45</b>                   |                              |                      |
| Context of the study          | <b>-0.27</b> | 0.00                  | <b>0.25</b>          | <b>0.56</b>                   | <b>0.35</b>                  |                      |
| Control                       | <b>-0.17</b> | 0.02                  | 0.06                 | <b>0.28</b>                   | <b>0.17</b>                  | <b>0.46</b>          |

## Discussion

As the most recent precolonisation non-human animal to arrive on the Australian continent, the ‘belonging’ of the dingo is ambiguous (Marcus 1989; Instone 1998; Franklin 2006). Furthermore, its propensity to hybridise with dogs arriving after colonisation leaves ample opportunities for it to be misunderstood in different contexts. The ambiguous identity of the ‘Australian dingo’, as discussed by Hytten (2009), is based on its classification as either ‘pest’ and a ‘hybrid’, or a ‘protected species’ and ‘pure’. This ambiguity is reflected in the published scientific literature on free-ranging dogs, which demonstrates significant variation in the preference for a common name. The strongest influence on common name preference in the scientific literature was whether the paper discussed or used data originating from control efforts on free-ranging dogs; those papers that did not utilise data from a control effort predominantly used the term ‘dingo’, while papers that discussed the results of a control program generally referred to ‘wild dogs’. Similarly, studies in a livestock production context, by authors employed by, or funded through, a livestock production company or institution, were more likely to use ‘wild dog’. By contrast, conservation context studies, those discussing mesopredator release, and those based in states with greater dingo genetic purity were more likely to use the term ‘dingo’. It is important to note that the control performed and the context of each publication, livestock production funding or employment, as well as mesopredator release discussion in the paper were strongly correlated. Nonetheless, acknowledging these biases can assist us communicate about the species with greater transparency and objectivity.

### *Are we controlling ‘wild dogs’ or ‘dingoes’?*

Historically, free-ranging dogs have often been labelled as a ‘pest species’ and have been controlled to mitigate impacts of predation on livestock (Hytten 2009). The term ‘wild’ often indicates a feral, uncontrollable species that warrants persecution and removal (Hytten 2009). A similar use of ‘wild’ has been suggested for ‘wild pigs’ (*Sus scrofa*) by Keiter *et al.* (2016), who suggested that the term ‘wild pigs’ be preferentially used in connection with ‘invasive’ and ‘non-native’ free-ranging pigs. As noted in the study of other invasive pests (Richardson *et al.* 2000; Colautti and MacIsaac 2004; Gobster 2005), terms such as

‘invasive’, ‘alien’ and ‘non-native’ terms evoke fear-based emotional responses (Richardson *et al.* 2000; Colautti and MacIsaac 2004; Gobster 2005).

Use of simple words or terms can allow rapid dissemination of scientific concepts (Colautti and MacIsaac 2004). However, they can also influence the ways in which scientists and the general public think about a species or issue. Indeed, it is known that proposals for control of a pest are more likely to be supported when there is a negative connotation to the terms for target species (Taflinger 1996; Fischer *et al.* 2013). Wording with negative connotations is evident in legislation and high-level policy documents around wild dogs. For example, the *National Wild Dog Action Plan* for Australia makes a clear distinction between the conservation of ‘dingoes’ and the control of ‘wild dogs’ (Wool Producers Australia 2014). Another example is the *Victorian Wild Dog Action Plan*, which discusses ‘dingoes’ in relation to hybridisation with domestic dogs and the ‘responsibility to conserve dingoes (*Canis lupus dingo*) on public land outside the 3 km livestock protection buffer’ (Department of Environment and Primary Industries 2013). The influence of different terms is also evident in public opinion. In a survey of a random selection of 2000 Victorians on the Australian Electoral Roll, 79% regarded ‘wild dogs’ as pests (Johnson and Marks 1997). Fitzgerald (2007) suggests that this result may be attributed to the fact that the public are less likely to challenge efforts to control ‘wild’ or ‘stray’ dogs than iconic ‘native dingoes’.

### *Paper context: conservation or livestock production*

The context of a study (i.e. livestock production or conservation) influenced the terminology used to describe free-ranging dogs. Use of the term ‘wild dog’ in the pastoral and agricultural sectors is likely to be intentional, with ‘wild dog’ used to avoid invoking positive attributes and responses attached to the term ‘dingo’. There has been an assertion that the ecological function of dingoes and wild dogs differ (Claridge and Hunt 2008), in other words that ‘dingoes’ perform an ecological role in the ecosystem (Johnson and VanDerWal 2009), while ‘wild dogs’ are perceived as a danger to livestock (Allen 2014). However, there has been little evidence to support this assertion, with livestock damage attributable to both ‘dingoes’ as well as ‘wild dogs’ (Claridge *et al.* 2014). To date, in-field identification of dingoes is not possible and methods of identification rely on the animal’s



death (Claridge *et al.* 2014). This is not useful when determining a culprit for livestock losses.

#### *Livestock production – authorship and funding*

Free-ranging dog predation on Australian livestock enterprises (sheep, goat and cattle) can be extensive (Fleming *et al.* 2012; Allen 2014). The costs of direct predation (killing or injuring livestock) and indirect impacts (such as stress to livestock) have been estimated at AU\$89 million per year (McLeod 2016). Mitigation of livestock predation by free-ranging dogs is not only performed by (or on behalf of) producers to reduce their financial and emotional costs (Binks *et al.* 2015), but it is a legal requirement in some Australian states. Many Australian states have legislation that requires landholders or state agencies to perform control. For example, in South Australia under the *Natural Resources Management Act 2004* (Government of South Australia 2004) the Department of Primary Industries is required to remove ‘pest animals’, including ‘dingoes’, that are perceived as a threat to South Australia’s primary industries. Again, in Western Australia, landholders are required under the *Biosecurity Agriculture and Management Act 2007* (State Government of Western Australia 2007) to control declared pests, including free-ranging dogs. In this context, major Australian livestock production organisations devote a portion of their Research and Development funding to research (and therefore publications) around the impact of free-ranging dogs on livestock. These organisations include Meat and Livestock Australia, whose vision is to be a leader in ‘world class research’ to benefit the livestock industry (Meat and Livestock Australia 2016). In most cases, if a paper’s author was employed in livestock production, and, to a lesser extent, if the funding of the study came from livestock production, then the paper was more likely to use the term ‘wild dog’ over ‘dingo’. It is unsurprising that employers and funders from the livestock industry, with a clear interest in the mitigating impacts of free-ranging dog predation, preferentially use the term ‘wild dog’ due to its often negative connotations, rather than ‘dingo’, which is more positively associated with iconic Australian wildlife and conservation goals.

#### *Mesopredator-release hypothesis*

Recognition of the role that free-ranging dogs play in the Australian environment shifted in the 2000s, with increasing interest in ‘top-down’ control of ecosystem processes through the presence of a top-order predator (Courchamp *et al.* 1999; Crooks and Soule 1999). Bradshaw *et al.* (2011) noted that the mesopredator-release hypothesis is one of the 20 most influential topics of biodiversity conservation. Before the 2000s, the term ‘mesopredator release’ was not present in the published literature on Australian free-ranging dogs, so it is not surprising to find that the decade of the study and mesopredator-release theory were correlated factors in the analysis. Twenty-two papers in the 2000s and another 105 papers after 2010 discuss mesopredator (feral cat and red fox) suppression by Australian free-ranging dogs. Papers discussing the mesopredator-release hypothesis are more likely to refer to dingoes than wild dogs for several reasons, including the potentially positive role dingoes play in an ecosystem that leads to the conservation of native

Australian species and therefore the conservation of dingoes themselves. Examination of the role played by native dingoes (avoiding the use of the term for non-native and invasive wild dogs) in suppression of these introduced predators and associated conservation benefits has been vigorously debated (e.g. Glen *et al.* 2007; Ritchie and Johnson 2009; Fleming *et al.* 2013). However, there is a rising consensus in the literature that study of this hypothesis is in its infancy, that mesopredator control is not applicable to all habitats and ecosystems (Claridge 2013; Morgan *et al.* 2016), has limited on-ground studies to back it up (Allen *et al.* 2017), and should not result in the abandonment of free-ranging dog control efforts (Wang and Fisher 2012; Allen *et al.* 2014).

#### *Variations with location of the study*

The relative contribution of purity of dingo genetic profile had minimal impact on the use of terminology to describe free-ranging dogs in the papers we reviewed. The historical (and continuing issue) of livestock predation by free-ranging dogs, and associated control effort, is evidently a stronger predictor of the use of free-ranging dog terminology (and perhaps instigator of research) in published works. We included the location of the study at the State level, but the exact location of each study is likely to have its own cultural values around free-ranging dogs, which play a strong role in the use of terms.

#### *Changes in common names over time*

Year of publication played a modest role in the differences in terminology for free-ranging dogs. Against the backdrop of changing functional and emotional relationships between people and free-ranging dogs, it is predictable that the names used to refer to them have also varied over time. Livestock predation by free-ranging dogs became a problem for the European colonists in Australia within a few decades of arrival, rapidly leading to most colonists viewing dogs as a pest species (Allen and West 2013). The impact of free-ranging dogs on livestock production persists to the present day and so does the debate on the role of the free-ranging dog in the landscape.

### **Conclusions**

Ambiguities around the status of free-ranging dogs, as well as these animals’ significance in both production and conservation contexts, mean that the way in which they are named takes on particular importance. Daniels and Corbett (2003), for example, suggest that those interested in conservation of dingoes, wild dogs, free-ranging dogs (and all other terms that cover these animals) should not concern themselves with the names used to describe the animal, and that we should accept that introgression has occurred, conserving instead the current population. In doing so, they recognise the significance of naming in shaping attitudes and perhaps, ultimately, policy. Our study, as the first to quantify common naming practices for Australian free-ranging dogs in the scientific literature, has identified patterns in these practices that suggest the influence of different conventions and/or interests.

Within the scientific literature, decisions on ‘what to call a dog’ are shaped by a range of factors. While the nature of our research has meant that it is unable to identify and quantify all



relevant factors, it has shown that the terms used were most closely correlated with whether the paper presented results from control efforts, whether the authors were employed or funded through livestock production organisations and whether there were discussion of mesopredator release. This suggests that a production or conservation orientation may have influenced the terminology used. The terms ‘dingo’ and ‘wild dog’ are not necessarily used deliberately in order to shape responses to the research, but may simply be derived from the conventions of different research contexts. Whatever the case, the names used to describe the Australian free-ranging dog will carry different connotations for diverse reader groups, and it is important that wildlife managers reflect critically on their use to ensure this does not hinder an open and effective debate.

### Conflict of interest

All authors declare there are no conflicts of interest.

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## Appendix 1. PRISMA flow chart (Moher et al. 2009), showing the steps taken to reach the final publications reviewed

