



Canis dingo and the Australian smaller-fauna trend: A new explanatory model integrating ecological data



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ARTICLE INFO

Keywords:

Canids
Archaeofauna
Historical ecology
Hunting dogs
Small game

ABSTRACT

This work examines recent efforts to use ecological and cultural functions of dingoes (*Canis dingo*) to explain a trend in the composition of Holocene faunal assemblages. Two competing explanations identify dingoes as causing human dietary composition to proportionally increase intake of small and medium-sized game, through competitive and assistive functions respectively. These scenarios are not mutually exclusive, but are in fact most convincing when working together. A new model combining this with three important ecological functions of dingoes is introduced, with specific mechanisms by which Holocene dingoes as apex predators and trophic regulators would have decreased large game abundance, and increased that of smaller game. This demonstrates how dingoes in both wild and domestic capacities created a suite of conditions that together made selecting smaller game a less risky, more attractive subsistence strategy for human foragers, thereby driving an archaeological smaller-fauna trend. Dingoes may also have been used to hunt large game reliably, but this was likely restricted to certain times and/or places.

1. Introduction

The dingo (*Canis dingo*) is a canid endemic to Australia, historically observed living both in close association with indigenous people, and as a free-living wild animal. The earliest detection of dingoes in Australia at approximately 3500 BP (Milham and Thompson, 1976) coincides with a period of high activity by Australasian maritime, which has led to suggestions that dingoes may have been introduced to Australia through contact with seafarers from India, New Guinea/Torres Strait, Taiwan, or Indonesia (Fillios and Taçon, 2016). Modern opinions rely on genetic evidence which presents conflicting introduction scenarios. Some analyses argue strongly for dingo dispersal via Austronesian agriculturalists associated with Taiwan (Sacks et al., 2013; Savolainen et al., 2004), while others raise the additional possibility of an earlier, pre-agricultural dispersal via mainland Southeast Asia and New Guinea (Ardalan et al., 2012; Cairns and Wilton, 2016; Freedman et al., 2014; Oskarsson et al., 2011). Despite their similar appearance to modern dogs from Southeast Asia, dingoes have recently been reclassified as a separate species (Crowther et al., 2014). Dingoes lack copies of the AMY2B gene found in most domestic dogs that promotes digestion of starchy foods (Freedman et al., 2014), which may reflect an origin amongst hunter-gatherers, or alternatively, could be a consequence of later adaptation to a starch-free diet in the Australian environment (Smith and Litchfield, 2009). Within this framework, Australian dingoes could represent an early lineage of Asian dog later replaced

elsewhere by newer breeds associated with agriculturalist dispersals (Ardalan et al., 2012; Oskarsson et al., 2011). The state of domestication the ancestors of Australian dingoes were in upon their arrival, and whether this developed in association with agriculturalists or hunter-gatherers, remains unclear.

Recent research identifies dingoes as primary agents in dietary trends observed in Australian archaeology. At several Australian sites diversifying changes in the composition of faunal assemblages have been observed in the latter half of the Holocene, where increases in frequency of small (< 5 kg) and medium-sized (5–10 kg) species are accompanied by decreases in large species (> 10 kg) (Balme et al., 1978; Balme and O'Connor, 2015; David and Chant, 1995; Dortch, 2004a,b; Fillios et al., 2010, 2012; Lourandos, 1983; Morwood, 1987; Porter, 1977). As this has been observed across different biogeographical and cultural regions (Balme and O'Connor, 2015; Fillios et al., 2010), some common process may be responsible. This pattern exists amidst a suite of changes to human socioeconomic systems that developed at the beginning of the latter half of the Holocene, including increased population sizes and settlement use, diversification of technology and diet, as well as the spread of the Pama-Nyungan language family throughout continental Australia (Hiscock, 2008).

Two current perspectives add dingoes to this mixture of contributing factors to change in the Holocene, both aiming to explain the smaller-fauna trend. In the 20th century dingoes were described as having been introduced alongside Holocene social/economic/techno-

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<http://dx.doi.org/10.1016/j.jasrep.2017.05.035>

Received 26 October 2016; Received in revised form 19 April 2017; Accepted 21 May 2017
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logical phenomena – a “cultural package” (Beaton, 1982; Bowdler, 1981; Flood, 1983; Hiscock, 1994), but this idea has since been discredited (Hiscock, 2008). A newer concept is that dingoes were actually causal factors in their own right that generated local development and dissemination of these cultural features. This appears to have first been raised by Flannery (2005), who briefly pondered a “dingo-driven revolution” where dingo predation of large macropods was responsible for Holocene group expansion, intertwined with increased reliance on grains and small game that became more abundant with the depression of these herbivores. Later, Fillios et al. (2010, p. 992) linked such predation with shifting prey abundances involved in development of the Australian Small Tool Tradition, although this idea does not seem to have been taken further.

2. Ancient dingoes and modern analogies

2.1. Competitive explanation

The first explanation for the smaller-fauna trend implicates wild dingoes as predators of large herbivores that reduced game availability to humans (Fillios et al., 2010; Letnic et al., 2014). Fillios et al. (2010) compared abundances of kangaroos on either side of the “dingo fence”, a barrier separating much of southeastern Australia from the rest of the continent, resulting in differential presence of dingoes on either side. Inferring the abundance of kangaroos in each area via counts of carcasses found lower abundances on the side where dingoes were more numerous, which implied that kangaroo populations were controlled by dingo predation more so than other environmental factors. In the mid-Holocene, this would have depleted large game resources for human hunters, triggering a switch to consumption of smaller game (Fillios et al., 2010; Letnic et al., 2014).

Fillios et al.'s (2010) research elaborated on earlier suggestions of dingoes influencing human prey-selection through competition. David's (1984a, 1984b) taphonomic analysis of the Walkunder Arch Cave archaeofauna, from north Queensland, suggested that dingoes depressed the local population's young wallabies through selective predation, limiting human hunting to older individuals. Similarly, McNiven and Hitchcock (2004) attribute extinction of macropods from the islands north of Australia to the arrival of dingoes. Fillios et al. (2010) additionally interpreted increased fragmentation of Holocene arid-zone faunal remains (Archer, 1977; Gould, 1996; Gould et al., 2002) as resulting from increased dietary stress attributable to dingo prey-suppression.

Research of the Australian Holocene has explored the role of climate in changes to social, technological and subsistence organization. Of particular interest is ENSO (El Niño Southern Oscillation) causing fluctuating and arid conditions during the latter half of the Holocene, which generated adaptive responses in human technological organization (Hiscock, 1994, 2002; Veth et al., 2011). Hiscock (2002, p. 170) describes this as a significant decline in rainfall after 5000 BP in eastern, northern and central Australia, with increased climatic variability until 2000 BP, after which rainfall increases again. This would have created long-term instability in the availability of human food resources, presumably including large herbivorous game. Dingo predation is ascribed by Fillios et al. (2010) influence comparable to climate and rainfall, in terms of triggering changes in human prey selection. These environmental drivers created instability in large game populations, but the addition of dingo predation caused further skew towards lower abundance.

The implication of a competitive explanation appears to be that human hunters with millennia of experience hunting large macropods and adapting to changes in their abundance were outcompeted by a novel animal species. That humans were outcompeted rather than simply engaged in competition is evidenced by that they altered their subsistence strategies to move away from larger game, whereas dingoes apparently did not (e.g. David, 1984a). Prey naiveté, the phenomenon

often invoked to explain the success of exotic predators (Moseby et al., 2015) cannot account for this trend, which spans millennia. As demonstrated here, however, this is not a simple case of animals outcompeting humans.

2.2. Assistive explanation

An alternative explanation of the smaller-fauna trend that centers on assistive aspects of domestic dingo behaviour has been proposed by Balme and O'Connor (2015). The authors argue that instead of changes in faunal assemblage composition reflecting differential prey availabilities in the post-dingo era (after 4000 BP), they actually represent domestic, human-associated (camp) dingoes being utilized as hunting assistants. In line with Smith and Litchfield (2009), they believe that the most significant contributions of meat by camp dingoes were small-to-medium sized animals. Naturalistic data cited regarding the dietary aspects of dingo ecology agrees with this perspective, emphasizing the small-to-medium prey aspect of wild dingo diets, especially where it is in comparatively greater abundance (e.g. Corbett and Newsome, 1987; Paltridge, 2002; Spencer et al., 2014; Vernes et al., 2001). Dingoes are thus viewed by Balme and O'Connor (2015) as opportunistic predators with the capacity to bring down larger prey, but only when it was abundant enough to warrant doing so and there were enough dingoes present to form a cooperative pack for the task.

A number of historical accounts attest to dingoes being used in an assistive capacity alongside humans to help procure game. An inconvenient issue with this literature that must be first addressed is the presence of domestic dogs (Gould, 1970; Hamilton, 1972; Hayden, 1975; Jones, 1970; Meehan et al., 1999; Thompson, 1949; White, 1972), which Aboriginal people often “replaced” dingoes with, including for hunting (Cahir and Clark, 2013; Smith and Litchfield, 2009). Dog and dingo-dog hybrids quickly became present at camps throughout the continent, reaching Central Australia by the 20th century at the latest (Horne and Aiston, 1924; Berndt and Berndt, 1945) but likely earlier, (e.g. Spencer, 1896) as they were in NSW by the 1830s (Lee, 1906), Victoria by the 1840s (Cahir and Clark, 2013; Griffith, 1845) and possibly even the Kimberley in the 1830s (Grey, 1841). We cannot consider the assistive hunting capacities of dogs to be interchangeable with those of dingoes, as many of the former were bred specifically for hunting purposes, and unsurprisingly they and hybrids seemed better at the task (Smith and Litchfield, 2009). This necessitated revisiting the literature to identify and exclude accounts that describe domestic dogs (Table 1).

In most ethnographic accounts describing dingoes, game procured is limited to small-to-medium species, including tree-kangaroo, possum, rat, snake, lizard, bandicoot, quoll, and echidna (Curr, 1886; Eyre, 1845; Lumholtz, 1889; Nind, 1831; Petrie, 1904; Smyth, 1878; Thompson, 1949). Some sources do not always specify what type of game dingoes helped hunt (Beveridge, 1899; Carter, 1911; Finlayson, 1943; Giles, 1889) while Lumholtz (1889, p. 179) stated they were indeed good for “every kind of game”. In his review of historical hunting methods across much of eastern, northeastern and central Australia, mostly concerning large game, Lawrence (1968) only noted a single instance in which “dogs” were used. Dingoes *did* feature in large-game hunts in some cases (Table 1) though they were often liabilities when pursuing large animals. In addition to cases in which dingoes lacked the speed or ability to take kangaroo and/or emu (Barrington, 1795; Nind, 1831; Petrie, 1904) there are accounts of dingoes and their hybrids ruining the hunt by interfering, making noise and revealing their presence (Gould, 1969), breaking cover to pursue the prey resulting in a tiring and fruitless chase (Gould, 1970; Hamilton, 1972; Kolig, 1978) and eating the prey before the hunter arrived (Kolig, 1978; Meggitt, 1965).

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