Applied Animal Behaviour Science xxx (2014) xxx–xxx

Contents lists available at ScienceDirect

Applied Animal Behaviour Science

journal homepage: www.elsevier.com/locate/applanim

Individual hunting behaviour and prey specialisation in the house cat *Felis catus*: Implications for conservation and management

Christopher R. Dickman[a,*], Thomas M. Newsome[a,b]

[a] Desert Ecology Research Group, School of Biological Sciences, University of Sydney, NSW 2006, Australia
[b] Department of Forest Ecosystems and Society, Oregon State University, Corvallis, OR 97331, United States

ARTICLE INFO

Article history:
Accepted 30 September 2014
Available online xxx

Keywords:
Diet
Feral cat
Predator
Predation
Prey selectivity
Prey switching

ABSTRACT

Predators are often classed as prey specialists if they eat a narrow range of prey types, or as generalists if they hunt multiple prey types. Yet, individual predators often exhibit sex, size, age or personality-related differences in their diets that may alter the impacts of predation on different prey groups. In this study, we ask whether the house cat *Felis catus* shows individuality and specialisation in its hunting behaviour and discuss the implications of such specialisation for prey conservation and management. We first examine the prey types killed by cats using information obtained from cat owners, and then present data on cat hunting efficiency on different prey types from direct observations. Finally, we quantify dietary shifts in cats when densities of their preferred prey vary. Our results suggest that cats can exhibit individual, or between-phenotype, variation in hunting behaviour, and continue to hunt specific prey types even when these prey become scarce. From a conservation perspective, these findings have important implications, particularly if cats preferentially select rare or threatened species at times when populations of these species are low. Determining whether prey specialisation exists within a given cat population should therefore be useful for assessing the likely risk of localised prey extinctions. If risks are high, conservation managers may need to use targeted measures to control the impacts of specialist individual cats by using specific baits or lures to attract them. We conclude that individuality in hunting behaviour and prey preference may contribute to the predatory efficiency of the house cat, and suggest that studies of the ontogeny and maintenance of specialist behaviours be priorities for future research.

1. Introduction

Predatory animals are commonly placed into one of two categories depending on the variety of prey that they include in their diet. Specialist predators, on the one hand, consume a narrow range of prey and may be critically dependent on just one or two prey species (Erlinge et al., 1984). Such predators often have morphological or physiological adaptations that increase their hunting efficiency and ability to handle or process particular prey, but decrease their efficiency in tackling alternative prey. Examples include ant-mimicking spiders that so resemble their formicid prey in appearance, odour and behaviour that they can raid ant colonies with little risk (Castanho and Oliveira, 2009), frog-eating bats that use the specific calls of anurans to target their prey (Ryan, 2011), and myrmecophagous animals that use specialised structures (e.g. spade-like digging claws, long, sticky tongues) to expose

* Corresponding author. Tel.: +61 2 9351 2318; fax: +61 2 9351 4119.
E-mail address: chris.dickman@sydney.edu.au (C.R. Dickman).

http://dx.doi.org/10.1016/j.applanim.2014.09.021
0168-1591/© 2014 Elsevier B.V. All rights reserved.

and then consume subterranean termites or ants (Redford, 1987). On the other hand, generalist predators have relatively broad diets (Erlinge et al., 1984). Some generalists eat different prey types in rough proportion to their availability in the environment, consuming them either via bulk ingestion (e.g. baleen whales that consume krill, fish and other small marine organisms; Watkins and Schevill, 1979) or with the use of traps that indiscriminately catch diverse prey (e.g. orb-weaving spiders; Nentwig, 1985). Other generalists have broad diets, but prefer or select some types of prey more than others (Corbett and Newsome, 1987).

The specialist–generalist dichotomy is usually applied to populations or species of predators to describe how the animals behave collectively. In the case of specialists, all individuals in a population will show similar foraging behaviour and share a common, restricted diet. In the case of generalists, however, the broad dietary breadth exhibited by a population may arise in two ways. Firstly, all members of the same population may have broad, generalised diets that include all components of the prey spectrum and thus differ little from individual to individual. Secondly, population members may each specialise on different components of the available prey spectrum. Here, individual animals behave as foraging specialists but the population, when viewed collectively, has a generalist diet. These two aspects of diet niche breath were distinguished by Van Valen (1965) and Roughgarden (1972, 1974a) and labelled, respectively, within-phenotype and between-phenotype components. Early research tended to emphasise the theoretical importance of these diet niche components, but empirical studies showed further that they could be employed to interpret patterns of foraging behaviour, competition and species composition in real world communities of fish, lizards, birds and other predators (Orians, 1971; Roughgarden, 1974a,b). Subsequent work has shown that predators often exhibit sex, size, age or personality-related differences in their diets (Brickner et al., 2014; Dickman, 1988), and that these differences can spread the impacts of predation across diverse communities of prey species (Bolnick et al., 2003; Yip et al., 2014).

Recent studies have uncovered between-phenotype foraging specialisations in populations of sea otters (Estes et al., 2003), guillemots (Woo et al., 2008), and sharks (Matich et al., 2011) and, increasingly, in large felids. For example, Ross et al. (1997) and Knopff and Boyce (2007) provided evidence of differential specialisation on deer *Odocoileus* spp. and bighorn sheep *Ovis canadensis* by individual cougars *Puma concolor* in Canada; Elbroch and Wittmer (2013) documented further individual-level hunting specialisations by the same species in Patagonia. Similar individual-level specialisation on different prey species has been shown within populations of jaguar *Panthera onca* (Cavalcanti and Gese, 2010), Amur tiger *Panthera tigris altaica* (Miller et al., 2013) and perhaps Eurasian lynx *Lynx lynx* (Odden et al., 2006). Individuality in predator hunting behaviour may arise as a learning process when young animals are being taught about sources of food by parents (Kuo, 1930; Woo et al., 2008), when independent animals discover new sources of prey or hunting locations (Cook et al., 2006), or if declines in prey numbers force animals to exploit different components in the remaining prey base (Svanbäck and Bolnick, 2005, 2007). Individual-level dietary specialisation by predators on particular prey can have dramatic effects on food web dynamics (Tinker et al., 2008) and, if preferred prey species are already scarce or threatened, targeted predation may place them at heightened risk of local extinction (Pettorelli et al., 2011). Felid predators pose particular problems for livestock if they learn to specialise on them (e.g. Linnell et al., 1999); in settled areas, rogue felids sometimes hunt and kill companion animals and may even target people themselves (Frump, 2006).

In this study, we ask whether the house cat *Felis catus* shows similar individuality in its hunting behaviour to some of its larger relatives, and marshal evidence from several disparate studies to address this question. We focus on the house cat for several reasons. Firstly, *F. catus* is ubiquitous. It is kept as a house pet or used as a pest control agent on every continent except Antarctica, and has established un-owned, stray or feral, populations worldwide (Denny and Dickman, 2010). Secondly, both domestic and un-owned cats have been shown to exact an enormous toll on wildlife. In the United States (US), for example, Dauphiné and Cooper (2009) concluded that cats kill over a billion birds annually. Loss et al. (2013) estimated further that cats kill 1.4–3.7 billion birds and 6.9–20.7 billion mammals each year in the US, with 69% of bird deaths and 89% of mammal deaths caused by un-owned cats and the remainder by their domestic counterparts. In Canada, Blancher (2013) put the annual loss of birds to cats at 100–350 million, with most falling victim to feral cats. Thirdly, there is some evidence that cats may develop marked individuality in hunting and killing behaviour, targeting such unusual prey as small bats (Ancillotto et al., 2013) and potentially putting rare species at particular risk. For example, no more than four cats were implicated by Gibson et al. (1994) in the demise of the rufous hare-wallaby *Lagorchestes hirsutus* at reintroduction sites in the Tanami Desert of central Australia, and a similar number of cats is thought to have extirpated the endemic wren *Traversia lyalli* on Stephens Island, New Zealand, within five years of their introduction (Atkinson and Bell, 1973; Galbreath and Brown, 2004). The predatory impacts of cats are notoriously difficult to manage (Denny and Dickman, 2010; Dickman, 2014; Loyd and DeVore, 2010). By understanding how cats hunt, and the extent to which they show individuality in hunting behaviour, we can gain clearer insight into both management tactics and strategy.

Based on the studies cited above, it is reasonable to expect that populations of house cats may show between-phenotype variation in hunting behaviour and preferences for particular prey types, and will do so irrespective of prey abundance. Given these expectations, we derive and test three contingent hypotheses. Thus, within cat populations we predict that:

(1) Individual cats will show distinct preferences for particular prey types,
(2) Individual cats will vary in the efficiency with which they hunt different prey types, and

Please cite this article in press as: Dickman, C.R., Newsome, T.M., Individual hunting behaviour and prey specialisation in the house cat *Felis catus*: Implications for conservation and management. Appl. Anim. Behav. Sci. (2014), http://dx.doi.org/10.1016/j.applanim.2014.09.021