Hunted Woolly Monkeys (*Lagothrix poeppigii*) Show Threat-Sensitive Responses to Human Presence

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Abstract

Responding only to individuals of a predator species which display threatening behaviour allows prey species to minimise energy expenditure and other costs of predator avoidance, such as disruption of feeding. The threat sensitivity hypothesis predicts such behaviour in prey species. If hunted animals are unable to distinguish dangerous humans from non-dangerous humans, human hunting is likely to have a greater effect on prey populations as all human encounters should lead to predator avoidance, increasing stress and creating opportunity costs for exploited populations. We test the threat sensitivity hypothesis in wild Poeppigi's woolly monkeys (*Lagothrix poeppigii*) in Yasuní National Park, Ecuador, by presenting human models engaging in one of three behaviours “hunting”, “gathering” or “researching”. These experiments were conducted at two sites with differing hunting pressures. Visibility, movement and vocalisations were recorded and results from two sites showed that groups changed their behaviours after being exposed to humans, and did so in different ways depending on the behaviour of the human model. Results at the site with higher hunting pressure were consistent with predictions based on the threat sensitivity hypothesis. Although results at the site with lower hunting pressure were not consistent with the results at the site with higher hunting pressure, groups at this site also showed differential responses to different human behaviours. These results provide evidence of threat-sensitive predator avoidance in hunted primates, which may allow them to conserve both time and energy when encountering humans which pose no threat.

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Introduction

Anti-predator responses can incur opportunity costs, reducing time available for feeding and other activities, or physical costs from energy expenditure or injury [1]. These costs can be reduced if prey are able to distinguish between dangerous and non-dangerous individuals of a single predator species. Not all encounters of prey with predators will be predation events. This may occur for a number of reasons; for example because the predator has recently fed, or if the prey gives alarm calls to a stalking predator and disrupts the hunt [2], [3]. If prey respond with anti-predator strategies to all encounters with a particular species, they may incur significant costs, particularly if the predator is common but attacks are infrequent. Prey which can distinguish between dangerous and non-dangerous individuals of a predator species and respond appropriately will reduce the costs of anti-predator behaviour [4]. This threat sensitive predator response, first suggested by Helfman [5], involves the prey altering their response depending on the magnitude of the threat. Threat sensitive predator responses been previously observed in damselfish [5], elephants [6] and larval treefrogs [7]. Helfman's study showed that damselfish showed stronger responses to predatory trumpetfish which were orientated vertically, indicating they were poised to strike, than to the same model orientated horizontally [5]. In general, threat sensitive predator reactions translates to increased responses when the threat, and therefore risk, is greatest.

Humans are an example of a common predator which does not always attack, and so are a predator to which threat sensitive responses would be particularly appropriate. Bates et al. demonstrated a threat sensitive response to humans in hunted elephants [6]. They conducted experiments where elephants were presented with cloths of different colours and scents. When presented with cloth worn by a Masaai (who hunt elephants), the elephants moved further, moved faster and took longer to relax than when they were presented with one worn by an individual from an ethnic group which does not hunt elephants. When encountering unscented cloths, they displayed more aggressively to the red cloths (the traditional colour of Masaai cloaks) than white cloths. We focus on primates because they are often preferred human prey species due to their relatively large size and conspicuousness, and are often vulnerable to overhunting due to their social nature and low rates of population increase [8]. Primates are particularly interesting as they are good candidates for showing a threat-sensitive response to humans, but this has not yet been tested. Humans are also the main predator of some primate species, yet have received relatively little attention as primate predators when compared with carnivorous