An Australian dung beetle, *Onthophagus ferox*. Extravagant horns come at a price.

JAN TAYLOR

generation, were already predator-savvy. Thus, the anti-predator behaviours are relearnt remarkably quickly.

These results raise both concerns and optimism. They suggest that, although such predator reintroductions can devastate prey populations in the short term, if the initial prey population is large enough to absorb the onslaught, recovery of prey can be swift and effective.

The researchers also suggested that similar rapid adaptive learning might have occurred in the Pleistocene megafauna, thus "tempering" the effects of any human overhunting. However, this extrapolation might not be justified. The naive prey populations in the study (Moose) had coevolved with their natural predators (bears and wolves) for at least tens of thousands of years, and had only been isolated from these predators for a geological instant (a century or less). These populations thus already possessed all the anatomical and behavioural traits for resisting predation, but had momentarily lost the ability to use them. In contrast, the Pleistocene megafauna of the Americas and Australasia, for example, had never encountered a human in their entire evolutionary history, and never evolved any appropriate defences. Without the behavioural and anatomical traits in their armoury to fall back on, these animals would have had to evolve entirely novel defensive repertoires in response to this new predator—a slow process that may have meant sustained mortality rates for lengthy periods...and eventual extinction.

—M.L.

Horny Beetles

Dung beetles sport horns that reach gigantic proportions and grow in extraordinary forms. Horns sprout from the front, back or middle of the head, or from the thorax. Despite this diversity, beetle horns all function the same way. Males use them to block the burrow entrance to keep rivals out and to safeguard their mate. Larger horns therefore have an obvious reproductive benefit, but why are horns so variable in their shape and location? A recent study by Douglas Emlen from the University of Montana suggests that functional costs influence horn design.

Emlen's study of *Onthophagus* dung beetles has shown that possessing extravagant horns comes at a price. Wherever horns grow, they stunt the development of nearby organs. Species with horns at the front of the head have small antennae and hence an impaired sense of smell (olfaction). Those with horns at the back of the head have smaller eyes with reduced vision. And beetles with horns on the thorax have smaller wings with diminished flight capabilities.

Each trade-off reveals the functional association between ecology and horn design. Most dung beetles need to see, smell and fly, yet the importance of these factors varies with the beetle's environment. For instance, nocturnal dung beetles need large eyes for seeing in low light, so the costs of producing horns at the back of the head (near the eyes) should be higher in nocturnal beetles than diurnal ones. Indeed, Emlen found that horns were significantly more likely to be located away from the back of the head in nocturnal dung beetles. Likewise, beetles inhabiting areas where dung is sparsely distributed rely on flight and well-developed olfactory senses. Emlen suspects that horns in these species will likely be found at the base of the head, so as not to impair the wings or antennae.

Emlen's study has shown that, while ornaments and weapons may have developed from the benefits of sexual selection, their diversity is driven by the cost constraints of ecology.

—K.H.