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## Ecosystem services provided by dung beetles in Australia

**Running title:** Dung beetles in Australian grasslands

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### **Abstract**

Although there are nearly 500 species of native dung beetles in Australia, most are adapted to small, hard, dry, pelletised marsupial droppings and not to dealing with the large, moist deposits of cattle. In 1788, Governor Arthur Phillip arrived at Botany Bay with five cows, two bulls, 44 sheep and seven horses: this signalled major changes in Australia. Now there are about 27 million cattle whose annual dung production has a dry matter content of about 42 million tonnes. Until CSIRO introduced exotic dung beetles in the 1960s, the dung of these herbivores sat on the soil surface, sometimes for years, locking up organic matter, smothering pasture and polluting waterways. CSIRO introduced 53 exotic dung beetle species, of which 43 were released to the Australian mainland between 1965 and 1985. Twenty-three of these have become established, many of which have reached the natural limits of their distribution. I consider the reason for the failure of the other 30 species to establish and briefly review previous contributions to examining the role of dung beetles in delivering ecosystem services, noting that much of the published literature concerns laboratory studies. New field data are then examined on the way in which introduced species are transforming dung communities and the

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