



## Review paper

## Introduced mammals on Western Indian Ocean islands

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## HIGHLIGHTS

- The distribution of introduced mammals was reviewed on the 28 Western Indian Ocean island groups.
- All island groups have been invaded by mammals, and invasive cats and rats in particular are ubiquitous.
- Introduced mammal eradications have occurred on 45 islands in the WIO region.
- Predator management has contributed to the recovery of 24 threatened species in the WIO region.
- Greater investment and prioritisation in island conservation in the region is warranted.

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## ABSTRACT

The diversity of introduced mammals and their introduction history varies greatly across the Western Indian Ocean (WIO) islands, from ancient introductions in the past millennia on islands off the East coast of Africa where extant terrestrial native mammal communities exist, to very recent invasions in the past decades on islands in the Mascarene archipelago. We compile the distribution of 16 introduced mammal taxa on 28 island groups comprising almost 2000 islands. Through an exhaustive literature review and expert consultation process we recorded all mammal eradications, and species recoveries which could be attributed to introduced mammal eradication or control. All island groups have been invaded by mammals, and invasive cats and rats in particular are ubiquitous, but cultural contingency has also led to regional invasions by other mammals such as lemurs, civets and tenrecs. Mammal eradications have been attempted on 45 islands in the WIO, the majority in the Seychelles and Mauritius, and where successful have resulted in spectacular recovery of species and ecosystems. Invasive mammalian predator eradication or control in association with habitat management has led to improved conservation prospects for at least 24 species, and IUCN red-list down-listing of eight species, in the Mascarene Islands. Future island conservation prioritisation in the region will need to take account of global climate change and predicted sea-level rises and coastal inundation. Greater investment and prioritisation in island conservation in the region is warranted, given its high biodiversity values and the extent of invasions.

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## 1. Introduction

The islands of the Western Indian Ocean (WIO) span 37 degrees of latitude from Socotra in the north (12°71'N) to Madagascar in the south (25°61'S). These tropical islands vary from massive islands of evolutionary diversification such as Madagascar to isolated coral atolls such as the British Indian Ocean Territory (Chagos Archipelago), and together are identified as one of the world's biodiversity hotspots (Myers et al., 2000). The region includes UNESCO World Heritage Listing for six insular nature sites and three cultural sites. Culturally the region has been the interface of surrounding continental dispersions, from seafaring Arabians and Africans expanding from the west, Indians from the north, Austronesians from the east, and finally Europeans commencing with Portuguese discovery around the early 16th century. The history of human colonisation is long and mirrors that of other island groups in the world such as the Pacific.

The earliest human voyagers transported mammals with them, often species which served as food resources or had some cultural value (Fuller and Boivin, 2009). Some commensal mammal species, particularly rodents, were unintentional introductions. Following colonisation some introduced mammal species might become feral on an island, whereby they establish self-sustaining populations in the wild. These feral mammals can go on to have negative effects on populations of native fauna and flora, other introduced species, or on ecosystem functioning, and subsequently disperse or be transported to surrounding islands in a group (Courchamp et al., 2003). This has particularly been the case on islands where the number of introductions has often been high, and the impacts more pronounced (Jeschke, 2008). The Mascarene archipelago alone has lost at least 74 vertebrate species due to hunting, habitat loss and predation, following the early 16th century first arrival of humans and their commensal mammals (Cheke and Hume, 2008). As well as generating biological impacts through predation, competition, hybridisation, and behavioural modification, introduced mammals are also a vector of diseases (e.g. leptospirosis) that can affect native mammals (bats, endemic rodents, etc.) and human health, and drivers of further human-induced alterations to the environment (Burns et al., 2016). Despite a long history of human presence, islands can remain vulnerable to species invasions, particularly of mammals (Ruffino et al., 2009). These invasions may be historical or contemporary, but in all cases will have had and continue to have impacts on endemic species and ecosystem functioning, which must adapt to a new equilibrium (Courchamp et al., 2003). In response to the spread of feral mammal populations, eradications from islands are now routinely used as conservation tools to allow the restoration of island ecosystems (Keitt et al., 2011).

Regional reviews of mammal invasion in the WIO are available (Fuller and Boivin, 2009), including the Comoros (Louette, 2004), Mozambique Channel (Walsh, 2007), Îles Éparses (Russell and Le Corre, 2009), Seychelles (Nevill, 2009; Beaver and Mougou, 2009; Rocamora and Henriette, 2015) and Mascarenes (Cheke, 1987, 2010; Cheke and Hume, 2008), as well as further reviews of individual island groups (see Table 1). We build upon these published works to present a pan-WIO perspective on island invasion by introduced mammals, and their eradication and subsequent benefits. We hope this work will act as a catalyst for further island surveys and mammal eradications for species conservation in the WIO region.

## 2. Materials and methods

We delimit the WIO region as the marine area bounded to the north by the Socotra and the Maldives, to the east by the Mascarene archipelago, to the south by Madagascar, and to the west by the Zanzibar archipelago (Fig. 1). We include the 'Spice Islands' (Pemba, Unguju and Mafia) lying off the coast of Tanzania within the region, although their classification as outlying islands is unclear (Walsh, 2007). We do not include other smaller continental islands chains of the East African coast, or Masirah Island off Oman. Our definition of island group is one of geo-political convenience, more or less identical to current regional delimitations. Specifically, we discriminate and define island groups by their geographic isolation from one another, and political administration. Island groups may consist of one or more geological independent archipelagos or atolls, and within each archipelago or atoll may be one or more 'islands', comprising islands, islets, rock stacks or atoll sand bars where permanently present above the high-tide mark, but excluding mangrove and sand bar islands in the deltas of rivers.

We compile the distribution of 16 known introduced mammal taxa on island groups of the WIO. This was undertaken through an exhaustive literature review of both electronic and print resources of published and grey literature, personal

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