

Invasive alien plants progress to dominate protected and best-preserved wet forests of an oceanic island



F.B.Vincent Florens^{a,b,*}, Cláudia Baider^c, Geneviève M.N. Martin^b,
Nooshru B. Seegoolam^b, Zeyn Zmanay^b, Dominique Strasberg^a

^a Université de La Réunion, UMR PVBMT (Peuplements Végétaux et Bioagresseurs en Milieu Tropical), 15, Avenue René Cassin, BP 7151, 97715 St Denis, La Réunion, France

^b Department of Biosciences, University of Mauritius, Réduit, Mauritius

^c The Mauritius Herbarium, Agricultural Services, Ministry of Agro-Industry and Food Security, Réduit, Mauritius

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ABSTRACT

Invasive alien plants pose a threat to biodiversity in particular on oceanic islands, where endemism tends to be high. In this context, it matters to characterise invasions *in-situ* and in particular to document how far invasive plants may invade protected areas devoid of major human disturbances. We explore this question on the tropical island of Mauritius, which provides an interesting case study because it possesses several attributes of human impacts, which are increasingly being encountered by most tropical oceanic islands worldwide. Mauritius today may thus serve as a “window” into the future of many other islands. We assess woody invasive alien plant abundance in the island’s wet native forests by sampling five of the currently best-preserved sites. We chose only protected areas that have benefitted from long-term legal protection. All woody alien plants reaching at least 1 cm of diameter at breast height (dbh) were identified and their dbh measured in a series of fifteen 100 m² quadrats randomly placed in each forest. All sites are today dominated by woody invasive alien plants, which comprised 78.5% of the 27 868 sampled plants ≥ 1 cm dbh. Density-wise, the alien shade tolerant strawberry guava (*Psidium cattleianum*) dominates all forests sampled. In terms of Importance Value (as percent relative dominance and percent relative density), *P. cattleianum* dominates four sites and another alien, *Cinnamomum verum*, dominates one site. Our study shows that even though relatively diverse, the native plant communities of an oceanic island cannot resist the encroachment of understory invasive alien plants, even in better preserved, least disturbed forests that have been receiving long-term formal legal protection.

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1. Introduction

Invasive alien plants (IAP) pose significant impacts at the species, community and ecosystem levels (Vilà et al., 2011), and this is particularly true on islands compared to mainland (Pyšek et al., 2012). Given the high level of endemism and degree of threats of insular biota, islands may offer particularly high returns per conservation effort (Caujapé-Castells et al., 2010; Kier et al., 2009). Locally, much of each island’s native biota subsists in the least disturbed habitats, which for this reason, tend to be prioritised for protection. In this context, it is useful for invasion biologists and

conservation managers to characterise invasions in these least-impacted and protected habitats that serve as last refuges for many endemic and threatened species. This can help gauging the level of risks faced by the biota which is benefiting from protection, and permit monitoring of trends through time, which itself may also help elucidate mechanisms and determinants of invasion.

Against this background, the tropical oceanic island of Mauritius provides an interesting case study of worldwide relevance because it possesses attributes of human impacts which are becoming increasingly evident on most tropical oceanic islands worldwide, including high human population density, high extent of habitat destruction and fragmentation or advanced levels of invasion by alien species (Florens, 2013). Mauritius may thus serve as a “window” into the future of many other islands. We selected five of the island’s best preserved, not logged wet native forests, which have been receiving protection for many decades on the basis of their well-preserved state, to determine the extent and major

* Corresponding author. Postal address: Faculty of Science, University of Mauritius, Réduit, Mauritius.

E-mail addresses: Vin.Florens@uom.ac.mu (F.B.Vincent Florens), clbaider@gmail.com (C. Baider), umrc53@univ-reunion.fr (D. Strasberg).

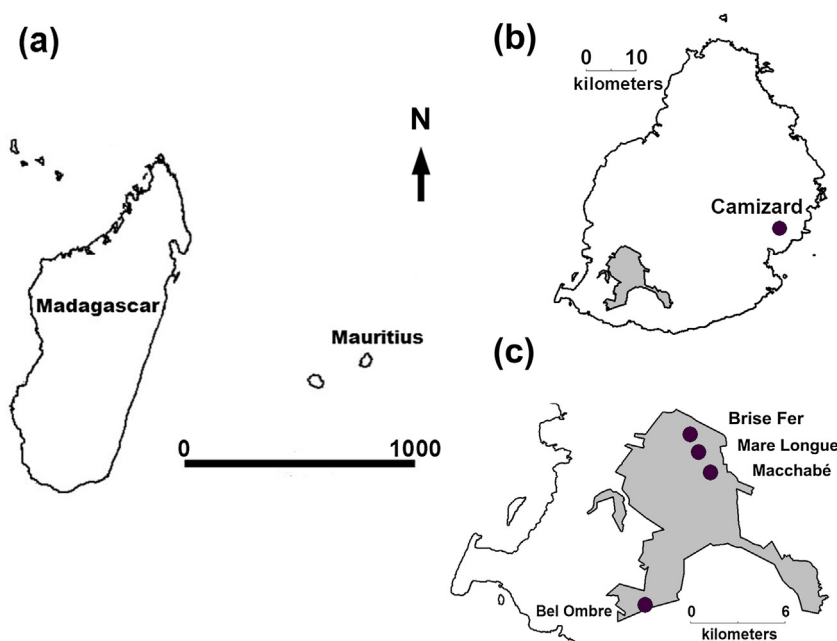


Fig. 1. (a) South west Indian Ocean showing Mauritius (upper right island) about 900 km east of Madagascar, (b) Mauritius, showing the Camizard site in the south east of the island and the Black River Gorges National Park (shaded) in the south west, (c) The Black River Gorges National Park, showing the four sites sampled therein.

characteristics of the woody alien plant invasion with the ultimate view of providing practitioners with information relevant to their conservation strategies and management. In particular, we sought to objectively characterise which alien species invade these protected and best preserved forests of the oceanic island and how dominant they are relative to each other and to the original native woody species.

2. Methods

Mauritius (centred on 20° 15' S and 57° 35' E) is an eight million year old oceanic island 1865 km² in area within one of the world's biodiversity hotspots (Myers, Mittermeier, Mittermeier, Da Fonseca, & Kent, 2000). Some 40% and 60% of its nearly 700 angiosperm species are endemic to the island and to the Mascarenes respectively (Baider et al., 2010; Baider, Florens, Rakotoarivelo, Bosser, & Pailler, 2012; Baider & Florens, 2013; Baider & Florens, 2016; Byng, Florens, & Baider, 2015; Fournel, Micheneau, & Baider, 2015; Le Péchon, Baider, Gigord, Ravet-Haevermans, & Dubuisson, 2011). Since human colonization in 1638, habitat destruction has reduced the island's native vegetation to 5% of its original extent (Florens, 2013). We selected five sites from within the three largest remaining forest blocks (all exceeding 6 km² (Safford, 1997)) to minimise the influence of habitat fragmentation, from which we deliberately chose the better preserved wet forests, that is, those dominated in the canopy by native plants, following the habitat classification by Page and D'Argent, (1997). These forests comprise about a third of Mauritius' surviving wet native vegetation (or about 30 km²). We thus purposefully avoided sampling smaller forest fragments because they would be most prone to the influence of habitat fragmentation. We also avoided habitats shown by Page and D'Argent (1997) to be most invaded and dominated by alien plants in their canopy. These avoided areas comprise the bulk or two thirds of the native habitats that survive today. We thus confined our surveys to what is today the least invaded habitats and the ones dominated in the canopy by native plants. It is important to note that all the surviving native forests of Mauritius are nowadays invaded by alien plants, whose introduction started since a little more than 350 years ago, and

that there are no published studies of Mauritius forests describing how they were before the invasion of alien plants. The first published forests surveys were done in the 1930's when it was reported that "it is now impossible to find even a small area free from exotics" (Vaughan & Wiehe 1941). We focussed on tall wet forests (height: 18–21 m; rainfall ca. 2000–3000 mm yr⁻¹). Sites sampled were Bel Ombre, Brise Fer, Macchabé and Mare Longue in the Black River Gorges National Park (BRGNP) in the south-west and Mt Camizard in mountain reserves in the south-east of the island (Fig. 1); all of which are non-logged and legally protected for several decades when they were selected as reserves by virtue of their then well-preserved native component. Before the areas that we surveyed were put under protection, they were among the most intact native forests that existed on the island, as was determined by studies done in the 1930's and published in early 1940's (Vaughan & Wiehe, 1941). The high density of native trees that these authors found in their studies – among the highest recorded for native forests worldwide (Leigh, 1999; Losos & Leigh, 2004; Vaughan & Wiehe, 1941) – testified to the well preserved nature of these forests at that time. The selected study sites are free from disturbances such as wild fires or landslides because they occur in too wet and flat areas respectively. All five sites have ferrallitic soils derived from basaltic lava flows at least 1.7 M years old (Montaggioni & Nativel, 1988) and a super humid mesothermal climate (Halais & Davy, 1969). The forest is dense with a canopy reaching 18–21 m (Lorence & Sussman, 1986; Vaughan & Wiehe, 1937).

Fifteen randomly placed transects of 25 × 4 m were sampled at each site from 2004 to 2005, totalling 0.75 ha at the five sites. Larger samples were impractical owing to the high plant density. In each sample, all woody plants ≥ 1 cm diameter at breast height (dbh) were identified, and their trunk diameter measured at 1.3 m above ground. Species were identified by the first author *in-situ* or using the regional Flora (Bosser, Cadet, Guého, & Marais, 1976). Infra-family nomenclature follows Bosser, Cadet, Guého, & Marais, (1976) except where newer authoritative literature exists. Description of each plant community was made through its species composition and relative importance values and its component parts. Importance value is a measure of how dominant a particular species is in an area of interest, and combines 'relative density' (i.e. the number

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